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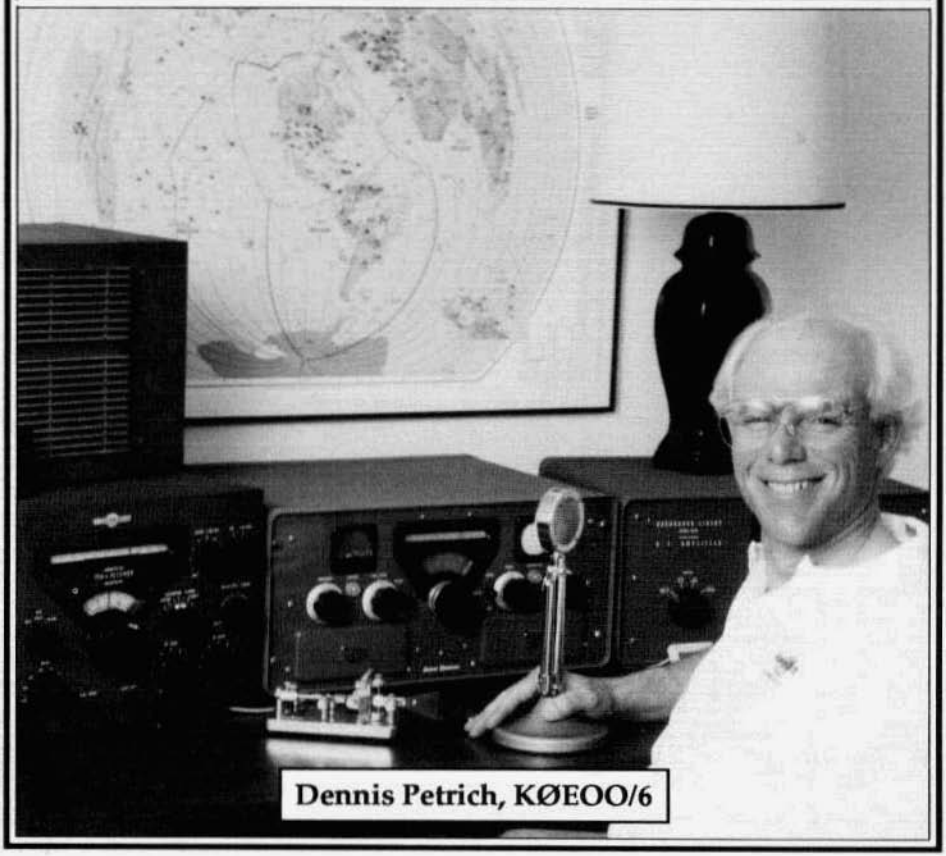
ELECTRIC RADIO

celebrating a bygone era

Number 48 April 1993



Dennis Petrich, KØEOO/6

ELECTRIC RADIO

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BILL KLERONOMOS, KDØHG.....VINTAGE PRODUCT REVIEWS
DALE GAGNON, KW1I..... AM REGULATION UPDATES

Electric Radio is published for amateur radio operators and others who appreciate the older tube type equipment. It is hoped that the magazine will stimulate the collecting of, and interest in, this type of equipment.The magazine will provide information regarding the modification,repair and building of equipment. We will also work to-wards a greater understanding of amplitude modulation and the problems this mode faces.

Electric Radio Solicits Material

We are constantly searching for good material for the magazine. We want articles on almost anything that pertains to the older amateur equipment or AM operation. From time to time we will also have articles and stories relevant to the CW operator and the SWL. Good photo's of ham shacks, home-brew equipment and AM operators (preferably in front of their equipment) are always needed. We also welcome suggestions for stories or information on unusual equipment. For additional information please write us or give us a call.

EDITOR'S COMMENTS Barry Wiseman, N6CSW/Ø

For some time I've been meaning to use my space here to talk about the Westcoast AM group that congregates nightly on 3870. Although I have checked in very infrequently since we moved to this QTH (low power, minimal antennas, etc.) I do listen regularly. I am very impressed.

First of all I find the group to be very polite to one another. I think this is important; we should all treat others just as we would like to be treated. Rarely is anyone skipped in the roundtable rotation (everyone seems to have a list of who is on frequency) and everyone takes notes in order to make comments when it's their turn to transmit. Although the "old buzzard transmission" has been an AM tradition, it's no longer acceptable with this group. Transmissions are typically 3-5 minutes and even when the group becomes very large everyone gets a frequent turn at the mic.

Besides the politeness, there's also a total lack of profanity or other ugliness. And I appreciate the way they ignore interfering stations even when the interference is obviously intentional. They've learned that the best way to discourage those kinds of people is to ignore them.

The great audio (several stations are truly outstanding) and interesting subject matter (diverse but mostly relating to radio) should also be noted. And I know from letters and calls I've received that shortwave listeners really enjoy listening to this group. It's hard to estimate how many SWLs might be tuned into 3870 on a given night but I'm sure the number is considerable.

I've invited John, W6BM (one of the stalwarts in the group, along with W6HDU, W6THW and K7INK/6) to produce a short article about the group for a forthcoming issue. It might prove to be a model for the new regional AMI groups that will be forming in the future.

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Cover: Dennis Petrich, KØEOO, at one of his vintage operating positions. In this issue (page 20) he contributes an interesting article on electronic TR switches.

Evaluating SSB With the Air Force

by Leo Meyerson, WØGFQ
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[Leo Meyerson was the founder of WRL in Council Bluffs, Iowa. His company produced such classics as the Globe Scout, the 'Champion' and the 'King 500'.]

In Ray Osterwald's series on the Collins 75A- receivers he mentions that the Air Force did some in-flight testing of SSB equipment back in the '50's. I was very fortunate to have been along on a five-day testing flight back in July of 1956.

General 'Butch' Griswold (KØDWC), who was Strategic Air Command (SAC) commander and a very good friend of mine, called me one day and asked if I would like to participate in some in-flight testing of SSB. He said that Art Collins would be going along , as well as some other Collins personnel and other military people.

The gear would consist of a KWS-1 and a 75A-4 for sideband and a Globe King 500 and another receiver (I can't remember what it was, maybe a National) for AM comparisons. Griswold was very familiar with the Globe Kings as I had lent one to him for his personal use. He thought it would be interesting to see how AM stacked up against SSB. Needless to say I was excited about the trip. It would be good to spend some time with Griswold and also Art Collins (WØCXX) whom I had met but couldn't say I really knew. Art and I became good friends on that trip and remained so until his death. I remember looking over the crew list and seeing myself listed as "antenna specialist". I suppose everyone had to have some sort of expertise listed in order to justify being along.

We took off from SAC headquarters in a lumbering, slow KC-97 aircraft. As soon as we got in the air Art Collins had his gear fired up and was working hams in rapid succession. (I wonder how many of those hams are still around who recall working us on that trip.) He also contacted military bases, particularly those who had been supplied with SSB gear in anticipation of the in-flight tests. Up till then AM was the primary voice mode used by all of the U.S. military. I think he may have worked some of the bases cross-mode as well. We did work some stations on AM with the Globe King but as I recall we used the SSB gear mostly as that was really the whole intent of the trip.

If it hadn't been for a calamitus event I may have had some good Globe SSB equipment along on the trip. Here's the story on that. In 1953 I had a very good engineer by the name of Fred Berry out of Kansas City design a SSB transmitter for me. When he brought the prototype to me, around Christmas of '53, I tried it and thought it worked great. I turned it over to my chief engineer Sam Fidone. Maybe that was a mistake. Sam was adamantly against SSB. He thought it sounded terrible and that it would never gain widespread acceptance. Anyway that was the last I ever saw of that transmitter. Sam said it had just "disappeared". Around that time we had our fire - that totally destroyed our building - and it may have been lost there, but I have my doubts about that. I went back to Fred Berry to have him build another one but he said he was involved in another project and couldn't do it. I then approached Wes Schum at Central Electronics up in Chicago. I suggested that we combine forces in order to develop some good SSB rigs. He said he couldn't leave Chicago, and of course I couldn't leave Council Bluffs so

I know the identity of only three people in the photograph. General Butch Griswold is in the center, Art Collins is on the right and I'm on the left. Butch and Art have passed on of course, but some of the others should still be with us. I wonder if anyone can provide information on these men. I contacted SAC headquarters to see if they had any information on this trip in their archives but they told me that they did not.

that was the end of that. Losing that first prototype transmitter set WRL back considerably in the development of SSB gear.

Our first stop on that trip was at a base in Maine. We then went on to Gander, Newfoundland and then to Goose Bay, Labrador and then on to Thule, Greenland. I think we spent a couple of days in Greenland. At that time of year in Greenland the sun never sets and we all had some difficulty getting to sleep at night. Another thing I remember is that one day we flew out on the icecap aboard a DC-3. Incidentally this aircraft was rocket assisted for takeoff. We landed and visited a complete Airforce installation that was in a huge cave carved out of the ice. There seemed to be everything there to take care of the big military staff; even a hospital. It was like an underground city. I had never seen anything like it.

The next leg of our trip was to Alaska. From there we flew to San Francisco. At San Francisco I left the group and met my family, who had come out for the National ARRL Convention. It was a fun trip.

Editor's note:

These days Leo devotes most of his time and energy to the amateur radio exhibit at the Western Heritage Museum in Omaha, Nebraska. Since he started it 3 years ago it has grown into a very substantial display. I believe this is the only display in the country that it entirely devoted to amateur radio equipment, and judging from the slides that Leo sent me recently it's all being done in a first-class way. *QST* will be doing an Upfront article on the Western Heritage Museum and in particular Leo's display in their April issue.

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"R-8040-- A Homebrew 80-and 40-Meter Receiver"

by Walt Hutchens, KJ4KV
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Part Two

The R-8040 started as an effort to build an 80-and 40-meter receiver in response to Barry Wiseman's request for interesting homebrew projects. Since the limit on what you can hear on these bands is interference from very strong signals on nearby frequencies, the design was to emphasize selectivity and strong signal performance; because I wanted to be able to listen to AM round tables for hours at a time and copy SSB when necessary, stability, a BFO, and good all-mode AVC were required. To limit front end complications a band imaging design covering 3800-4000 and 7100-7300 kcs was chosen.

The outlines of the design were covered last month in Part 1; in this part we'll look at some details. A package containing larger circuit diagrams, a parts list and more than 20 pages of notes is available from me at the address above for $6.

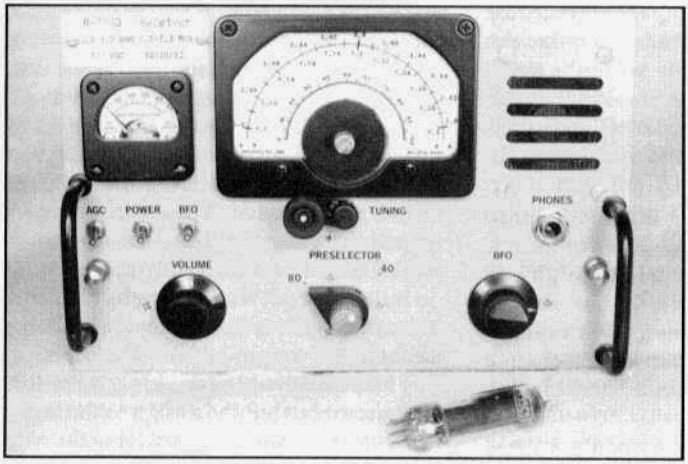
Preselector and Mixer

Fix-tuned bandpass circuits are sometimes used in the preselector (what we used to call the antenna and RF circuits) but the goals of the R-8040 called for two tunable circuits here. I did compromise to the extent of arranging the circuit to tune both bands so a bandswitch and second set of coils would not be needed. As you tune the preselector from one band to the other you go past the IF frequency and the mixer breaks into oscillation; this is noticed as a series of clicks and causes no problem.

Many authors of receiver articles emphasize the importance of high-Q coils in these circuits and they are right. When I replaced the small slug tuned coils with which the receiver was developed with high-Q toroids the sensitivity improved by over 10 dB and the front end bandwidth dropped to under 10 kcs on 80 meters -- a great help in keeping strong unwanted signals out of the mixer. The preselector tunes so sharply that a vernier drive is essential.

The main job of an RF amplifier is to boost the signal above the noise generated in the mixer. On 80 and 40 meters, however, the external noise level is usually so high that signals below a microvolt can't be heard; it is easy to build a mixer which is quieter than this. Moreover, increasing the signal level ahead of most of the selectivity means more chance for overload problems to occur. The R-8040 does not use an RF amplifier.

Through the 1960's, most ham receivers used pentagrid tubes such as the 6SA7 or 6BE6 as mixers. These tubes are good strong signal performers but they are very noisy. The best 'hollow state' HF mixer is probably the 7360 beam deflection tube, which is reasonably quiet and has outstanding resistance to strong signal problems: from the tube characteristics it appears that it would handle input signals giving over ten volts on the grid without serious trouble! However because the 7360 is rare (and expensive:$25 to $27) and would not fit the series string configuration I wanted to use, I chose a 12AT7 dual triode circuit noted for fairly good strong signal performance at the price of being moderately noisy. Since this stage is not preceded by an RF amplifier and gets some protection against strong off-channel signals from the high-Q preselector coils, 'fairly good' is good enough. The circuit has the added advantage of being 'almost' double balanced: because of the unbypassed cathode resistor the oscillator and RF signals mostly cancel themselves out in the plate circuit.



The Local Oscillator

It is amazing that among the U.S. big name manufacturers only Collins seems to have realized that an oscillator having all the tuned circuit parts in a closed box with no heat sources can be much more stable than one built on an open chassis with the same parts. This design (which I have come to call a 'unit oscillator') keeps all the parts near the same temperature, which makes possible much better compensation than if they heated and cooled independently.

To keep heat away from the tuned circuit, the oscillator tube is mounted on a shelf attached to the rear of the box with plastic hardware and with a 1/4" air gap between it and the box. Connections to the tuned circuit are made with no. 30 wire-wrap wire to avoid conducting heat from the tube. The power and output leads are connected to the set by plugs.

I started with a Hartley ECO unit oscillator left over from another project. It turned out, however, that the strong harmonics for which ECO circuits are noted caused spurious responses. Finally I rebuilt this unit using a triode Colpitts oscillator circuit with output taken from the plate end of the tank where it appears across a 2400 mmf capacitor. At this point the waveform appears to be a perfect sine wave when seen on a 'scope. Presto! No more spurs caused by oscillator harmonics! When the oscillator was tested with a direct connection to the mixer, strong signals made the frequency jump around by a few tens of cps -- too much to give clear reproduction on SSB signals. Adding the buffer stage eliminated the instability.

The Crystal Filter

A filter for AM use must pass the carrier as well as at least one sideband so you need at least 3 kcs bandwidth. So-called 'ladder' bandpass filters using several crystals of the same frequency have the advantage that the width and flatness can be adjusted by using more or fewer crystals and changing the capacitors and resistors rather than having to change crystal frequencies as for other circuits. The R-8040's filter uses five crystals with a series resonant frequency of 5550 kcs. The circuit shown gives a lower edge of about 5551 kcs and an upper edge just above 5554 kcs. The filter is placed right after the mixer in order to knock off unwanted signals before they are amplified to the point where they cause trouble.

The IF Amplifiers

Since the signal reaching the first IF stage is small, this stage must have high gain if it is not to contribute significant noise. I settled on two stages using the 12BZ6 semi-remote cutoff pentode. With a mu of about 8000, these tubes deliver considerably more gain than the 12BA6, let alone the various octal pentodes. (*)

Careful attention to shielding and bypassing is important here not only to prevent oscillation but because regeneration will destroy the flat bandpass of the crystal filter and because coupling forward (along the same paths) will allow leakage of signals around the crystal filter and the IF tuned circuits.

continued next page

As in the preselector, the IF coils are toroids. The high Q of T2 and T3 helps the skirt selectivity and the toroid's well-contained magnetic field makes it easier to avoid stray coupling. Both IF stages are controlled by AVC.

The Detector

* Other things being equal the noise generated in a stage goes down as the mu (Gm) of the tube goes up. Although it is usually given in micromhos, mu is easier to think about if you remember that if a tube has a mu of 1000 then a 1 volt change of grid voltage produces a 1 mA change of plate current.

The R-8040 was to be mainly an AM receiver so it needed a real AM detector. However signal levels at the detector are too low for a diode to work without lots of distortion. The plate detector works well on small signals and also gives substantial gain. Its weakness is distortion on large signals but with feedback from the following audio stage to the cathode of the detector tube and good AVC there is no distortion you can see on a 'scope even at the maximum signal level.

The AVC Circuit

AVC voltage can come from either the carrier or the audio. Carrier AVC would have been tricky for the R-8040 because of the low-level detection but since the receiver was to operate on SSB, audio AVC made sense anyhow. The signal is taken from the plate of the second audio amp.

A disadvantage of audio AVC is that if a short time constant is used the gain comes up between words which makes the average noise level increase. A long time constant, however, causes the receiver to recover slowly after a strong signal. The answer is so-called 'hang' AVC. In this circuit, one AVC path controls the receiver gain in the conventional manner except that there is no discharge resistor across the filter capacitor. A second path gets the same input signal as the first but uses it only to cut off a cathode follower connected to the AVC line. The circuit is arranged to cut off the cathode follower for about half a second after a voice peak; during this time the AVC voltage remains constant. When the follower conducts, the AVC voltage is rapidly reduced.

The R-8040's AVC is good enough that if you use headphones and disconnect the antenna on transmit, muting the receiver isn't needed. You hear your own signal in your headphones (a feature called 'sidetone' which is always provided in military sets); when you stop transmitting the receiver comes to life in half a second.

I had intended to provide a noise limiter circuit but left the design to the last. It turned out, however, that driving the AVC from the second audio plate provides a useful limiter circuit: short noise pulses are partly soaked up in the AVC cathode follower grid capacitor! Now how often in life do you get something for nothing and then discover that it was something you actually wanted?

The BFO

A BFO was needed both to allow copying SSB and because eventually I want to provide an exciter output for use in an associated transmitter. Since the BFO had to operate at 5.55 Mcs, a stable tunable oscillator would not be easy to build so I settled on a 'rubber' crystal using an extra left over from the IF filter. The only disadvantage of the circuit shown is that it doesn't quite cover the filter bandpass but this causes no practical difficulty. Careful shielding and decoupling is important here to minimize leakage of the BFO signal into the mixer where it would be controlled by the AVC and could cause spurious responses.

Power Supply

The tubes were chosen to have equal filament currents and filament voltages which added up to about 120 volts so they could be connected in series and operated directly from the line. The plate supply is a half-wave rectifier; the only novel feature of the circuit is the inclusion of L12 to reduce the rectifier peak current. This reduces hum caused by the large peak

current flowing in the neutral line but it is also a kindness to the rectifier and filter capacitors and gives a much 'stiffer' HV supply than the use of a series resistor. With a relatively stable AC line, a local oscillator which isn't much affected by voltage changes and HV which doesn't vary much as the load changes (for example when the IF stages are nearly cut off by a strong signal) the usual VR tube wasn't needed.

Transformerless sets seem to have a poor reputation, but except for the 'line cord roulette' version in which what you hope is the neutral side is connected to the chassis, this is a bad rap. With a three-wire cord, the neutral isolated from the chassis, and provided that one always uses a tester to be sure that the outlet is wired right (mainly that the ground pin is actually grounded), they are no more hazardous than other types.

Performance

I gave a few numbers in Part 1, but they were scattered, most were given without comparison, and some have been improved since then. All measurements were done at 3900 kcs. See Fig. 1.

Conclusions

Under this heading I usually pick apart other people's designs; let's see what happens to the R-8040.

Beginning with the positives, this is an innovative design. The low radio-frequency signal levels made up by low level detection and high AF gain, the transformerless power supply, the modified plate detector, the audio AVC using an RC-coupled voltage doubler, the unit oscillator construction and the crystal controlled BFO are all rare or unique among small homebrew receivers.

Overall performance is unusually good for a set of this size and modest complexity. With a crystal controlled BFO, IF selectivity set by a crystal filter and a local oscillator which drifts less than many crystal oscillators, the R-8040's stability is outstanding. AVC performance (under 5 dB output rise from 5 uV to 50,000 uV)is good: about all you can expect with only two controlled stages. Close-in selectivity is adequate, with a ratio of 60 dB and 6 dB bandwidths ('shape factor') of 2.8. The IMD performance beats all but the top receivers, especially when you consider that the 80 dB dynamic range is measured from the receiver's relatively high noise level. Weak spurious responses to internal signals occur when the BFO is ON and a multiple of the local oscillator divides evenly into a multiple of the BFO frequency; none of them can be heard when there's any atmospheric noise.

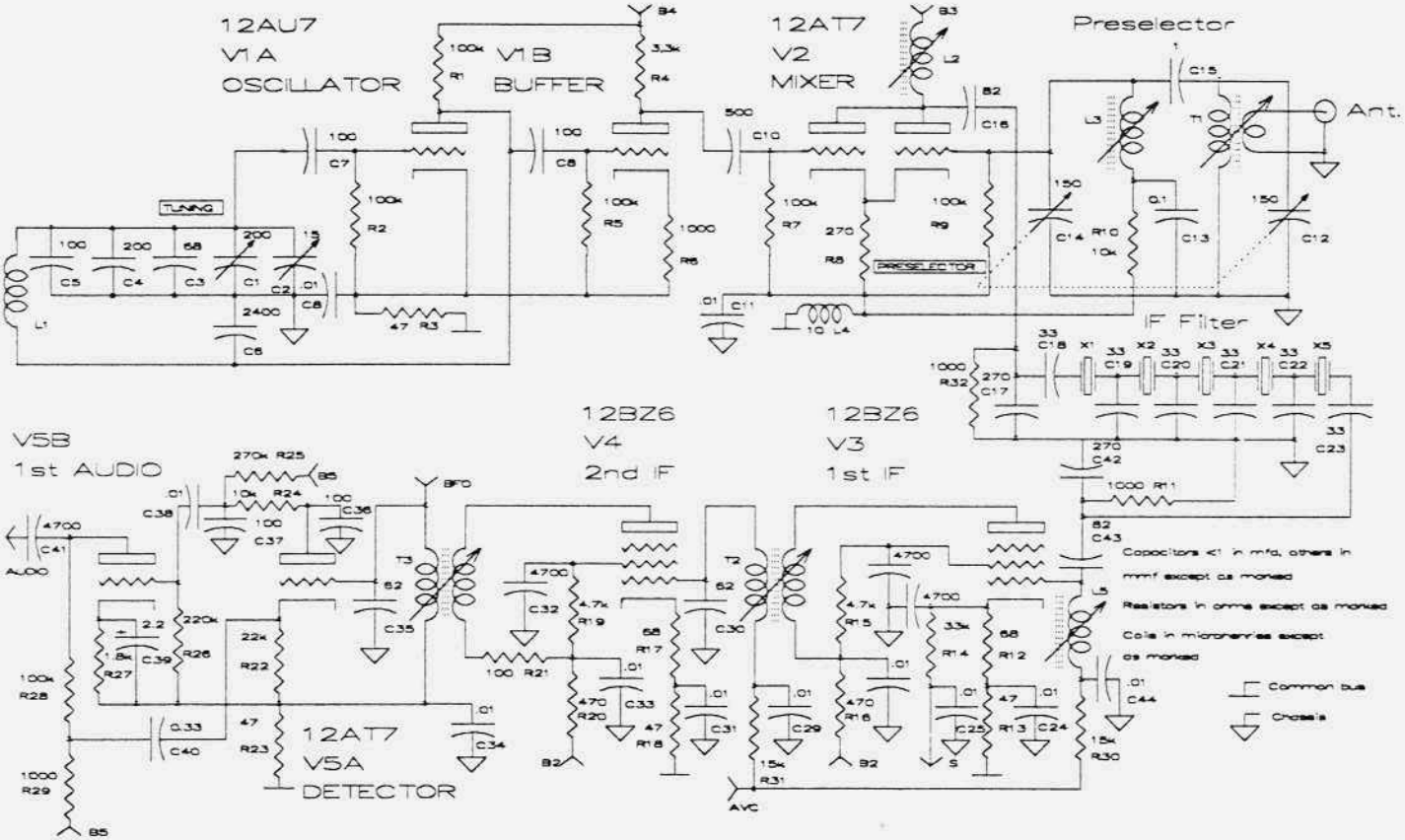
At an average of 13 kcs/revolution, the tuning rate is better (slower) than all but a very few ham sets, however the crank tuning knob makes quick frequency changes possible. SSB reception using the BFO is excellent except that when receiving very strong signals under quiet band conditions the AVC causes considerable distortion on the first word after a pause.

The goal of a 'set and forget' receiver for roundtables and nets was fully met. About the only area where the R-8040 takes a back seat to other receivers is in digging for weak signals: its front end just isn't quiet enough to copy the very weakest signals under ideal band conditions.

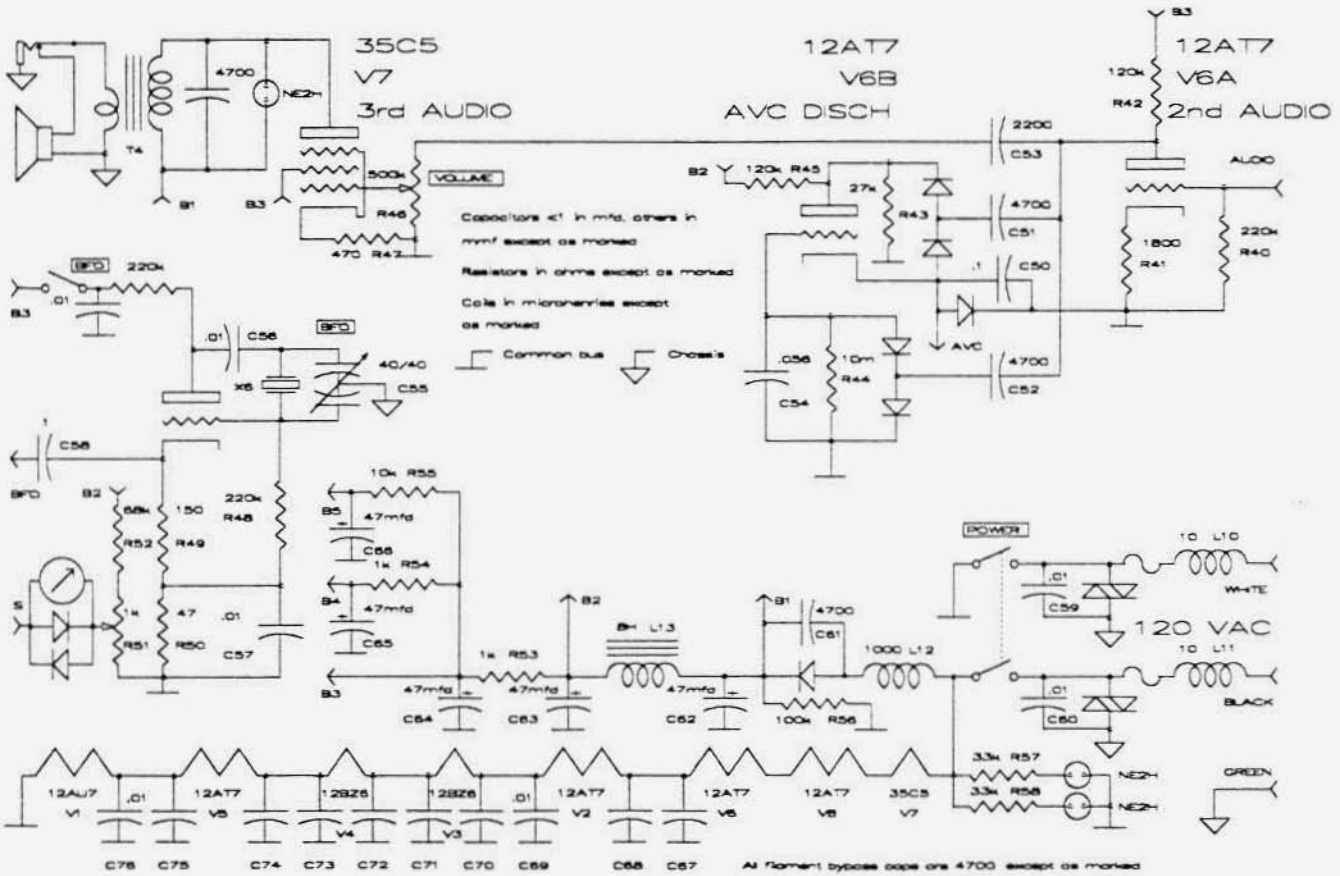
The most serious weakness is cost: the six crystals had to be custom made at a cost of $75. To that you can add $45 for the tubes, $25 for small parts and whatever price you assign to a good tuning cap, speaker, chassis, dial and drive, knobs and other items which were in the junkbox here. You can buy a pretty good receiver for less than the cost of building this one.

There are a number of smaller problems. Because the dial was marked for a 5550 kcs IF but the actual center frequency is about 5552.5 kcs, there are significant calibration errors. The 2" x 3" vintage loudspeaker would be hard to replace. There is a microphonic 'howl' from the 12AT7 detector when you tune in a strong unmodulated carrier when using the loudspeaker. The BFO produces a noise level of several S-units. At full volume you can

Schematics on following pages, text continues on page 34



R-8040 Schematic -- Part 1



R-8040 Schematic -- Part 2

The DX-100: Heathkit's Big Gun

by Chuck Penson, WA7ZZE
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St. Paul, MN 55102

When Heath fired off the AT-1, it should have been a shot heard 'round the world—or at least it should have been heard as far away as Waseca, Minnesota. Apparently it was not.

With the AT-1 out the door and selling very well, Heath's assertions that there was a market for high-quality ham gear in kit form had been proved correct. In addition, Heath now suspected it could make virtually any amateur product in kit form, make it just a little better, give it a few more features, and still be able to sell it for less than a ready-made rig.

In deciding on their next product, Heath used the same strategy it had used with the AT-1—it looked at the competition. Thumbing through back issues of *QST*, it looked to see what was missing. There were plenty of receivers. Everybody was making receivers—good receivers. But receivers were tricky and designing one would take more time than Heath had. To keep the ball rolling it needed another product quickly.

The answer was AM transmitters and specifically AM transmitters in the 100 watt range. There were almost no affordable AM transmitters in this range on the market. There was the B&W 5100S. A mere $467. There was also the Collins 32V-series of transmitters, out of reach of most hams, selling in the $700 range. Heath had to wonder what was going on? Couldn't anyone make a nice 100-watt AM transmitter with a few features and a little muscle and still sell it for less than a 1954 Buick four-door? Heath didn't have to sniff very hard to smell a market here.

No affordable AM '100-watters? Well, there was one. It ran around 100 watts AM and CW, on 160-10 meters. It was built into a nice looking cabinet 20 inches wide and 10 inches tall, and weighed an easy-to-lift 65 pounds. All things considered, it was a real nice design. And at only $280, it was affordable. It was offered fully assembled—or as a kit. As far as Heath's engineers could see, it had only one weakness—no VFO. This, Heath concluded, was a radio (and a market) it could go after. The rig was the Viking II, and in a very short time, the E.F. Johnson Company of Waseca, Minnesota, would find itself looking down the barrels of the Heath Company's large caliber engineering and marketing guns.

But there was a hitch. Heath had become accustomed to inexpensive parts—like the warehouse full of surplus parts that had propelled it into the business to begin with. It was easy enough to go after ready-made products when you had that kind of ammo, but now Heath was dueling with the well-armed Viking II—another kit. And to make matters more complicated, the warehouse was just about empty. What to do...

Let's make a deal.

By this time, Heath had become a major player in the test equipment and hi-fi markets. It was buying major league quantities of transformers, switches, coils, capacitors, and almost everything else. With this kind of buying power Heath didn't have to look far for suppliers willing to deal. Companies like Chicago Transformer, Simpson, Centralab, Cinch, and Mallory were falling all over themselves to talk to Heath, and they weren't just talking about off-the-shelf parts—Heath took the opportunity to begin having parts tailor-made. So with a ready

supply of low-cost custom parts in hand, Heath turned once again to Roger Mace, their chief ham products engineer, and said in effect, "go get 'em". This was probably early in 1954.

Heath's new transmitter, dubbed the DX-100, ("DX" seemed like a good idea) would be designed to give the Johnson Viking II some genuine competition. It would have everything the Viking had—plus a VFO. Target price: $100 less than the Viking.

To appreciate the design of the DX-100, one must have an understanding of the times. The DX-100 was designed at a time when "big" and "heavy" were synonymous with "good" and "stable". Prior to 1958 it was axiomatic that if a rig weighed less than 50 or 60 pounds it was not very well designed. A big heavy radio was what everyone wanted. It was also assumed in those days that a rig should be designed—or more precisely, over-designed—to withstand any peril that might come its way. There was, apparently, a lot of military-like thinking that went into these radios. Hence, huge transformers, heavy resistors, high working voltage capacitors, and over-rated parts of all description found their way into the circuits. Hey, we are talking "red menace" here. These rigs needed to be tough enough for "the big one". One might be tempted to counter that in those days parts were cheap. Certainly chokes and coils for 35 cents and high-voltage air variables for two bucks sound cheap, but two bucks was a lot of money in 1953. When thought of in terms of 1950s dollars, parts, with very few exceptions, were

continued next page

no cheaper than they are today. Like other manufacturers, the Heath Company was a product of its times and bought into much of this over-design theory of construction. But it could over-design and still save money. How?

Can you say, "reverse engineering"?

There was a simple formula here that Heath had discovered years earlier. Find a successful product, buy a couple, then take them apart and see how they work. Then design your own version—with a few improvements and extra features. All you need are a few veteran home-brewer types—graduate engineers need not apply. You save big money! Simple enough. This was the strategy Heath had used in developing much of its test equipment, and it seemed to work. Did Heath do it with the Viking? Only God and Roger Mace know for sure, but it seems a likely scenario given the similarity of design and layout. Money could also be saved with Heath's remaining surplus parts—resistors, capacitors, and lots of other small parts acquired for almost nothing. And in the final analysis, Heath could always reduce its profit margin a little.

Now then, what was the first ingredient in a good transmitter? That's right—weight. And there's no better way to bulk up your rig than to start with good old solid steel—and lots of it. Heath began with a heavy gauge copper-plated steel chassis, an 1/8 inch thick aluminum front panel, and a heavy, multi-piece steel cabinet. The DX-100 weighed 40 pounds before the first transformer was installed. And speaking of transformers, another sure-fire strategy to weigh down your rig is to use lots of big conservatively rated transformers in the power supply. Tradition dictates that the power supply of a good transmitter uses at least two big transformers, and if you want to do it right, you'll throw in a big choke or two as well. Heath used one transformer to provide low voltage, bias, and filament power, and a second for the high voltage. A 5V4 was used in the low-voltage circuit, followed by a 7-henry choke and for good measure, an 0A2. The bias supply used a 6AL5, and for the filaments there was a big 12 volt 4 amp winding. The high-voltage section used a pair of 5R4GYs with a 5.5-henry choke.

Having satisfied himself that the DX-100 was suitably massive, Mace set about designing the innards of the transmitter.

In most respects the DX-100 was a pretty conventional design. The crystal oscillator was a modified Pierce type running with a 12BY7—essentially a grounded Colpitts. Heath was fond of this type of oscillator because it was simple and stable. The VFO was another Heath favorite. It was a Clapp oscillator using a 6AU6. Great pains were taken to prevent drifting. The tube was mounted outside the enclosure and all internal VFO parts were rigidly mounted.

Mace chose to use 1625s in the DX-100's modulator instead of 807s like in the Viking II and there's a simple reason why—Heath had a ton of them, mostly surplus. The 1625 was the amplifier of choice in high fidelity audio, and Heath made a lot of great hi-fi gear. (This may or may not explain the DX-100's legendary audio.) 1625s could be pushed as high as 120 watts and, while 80 or 90 watts would suffice (and would lengthen the life expectancy of the tube considerably), many ops couldn't resist the urge to push the tubes just a little higher. Heath ran the modulator in AB2 just like the Viking. Frequency response in the 100 was limited to a range of about 250 to 3000 Hz by means of a couple of small caps on the high end, and by using the modulation transformer as a low-pass filter on the low end. Incidentally, the modulator output was available through a socket on the rear panel and could be used to drive a public address system, though history does not record anyone actually doing this.

The final amplifier was designed with the tubes that would become something

of an industry standard—the 6146 (as in the Viking). Introduced in 1952, these little gems were making RCA richer than it already was. Heath used a pair of 6146s in the DX-100 and would use them in almost every future transmitter it sold.

Of course every good amateur knows that what makes a transmitter truly great is its ability to load into bedsprings. And so as not to disappoint, Mace used the old reliable pi-network in the output circuit.

When all was said and done the DX-100 ended up weighing a nice even 100 pounds—it had "stable" written all over it. It used 15 tubes, would run 125 watts AM, and 140 watts CW. In addition, it had a VFO and was $100 less than the Viking. Heath sent it out the door in the spring of 1955 and yes, it was a phenomenal success.

The two-tone gray DX-100 and 100B (there was no "A" version) were the first of Heath's "Big Guns" and the first in the famous "DX" series. Mace had done a splendid job designing the rig and there wasn't much to fix—the 100B was released in 1958 primarily as a cost cutting measure—but he took the opportunity to do a little bit of fine tuning.

There were some significant differences between the 100 and 100B. For starters, the 100 was built on a copper-plated chassis with a clear lacquer coating while the "B" was build on a zinc-plated chassis with no coating. The 100 provided selection of four crystals or the VFO from a switch on the front panel. In the B version, there was only one crystal available—from a switch inside the cabinet. The 100B was pre-punched for two SO-239s (not included) for those wanting to modify it for use with the SB-10 SSB adapter. The 100 used a combination of stepped loading (for coarse adjustment) and variable capacitor loading (for fine tuning). This scheme was replaced in the 100B with a larger gear-driven variable cap less prone to arcing—a modification kit was offered for DX-100 owners.

The most obvious change in the "B" version was the cabinet. The multi-piece cabinet of the 100 was replaced by a one-piece formed cabinet with a hatch on the top through which one gained access to the crystal and made other adjustments. There were also some minor changes in the loading and crystal circuits, and changes in the output circuit as well. The original would match from 50-600 ohms. The "B" was somewhat less forgiving and would match only 50-72 ohms.

At least one advertising photo shows the 100 with a plastic panel meter of the variety used on the DX-40, though it is unclear to me if any were ever released with that style of meter. However, Heath did release a British version of the DX-100 called the DX-100U. It was identical to the U.S. version, except that it had a different paint design—and used a plastic meter!

Even before it went out the door, Heath knew it had a winner in the DX-100. But it was also quick to realize it didn't matter how good a product you had if no one could put it together. To win in the kit market you needed clear, understandable manuals. While engineers like Mace were still writing the basic step-by-step instructions, Heath had hired a few graphic artists to help with the illustrations and a few editors to help make sense of the engineer's often over-technical style. In fact, there was now an entire "manuals department." This was the other part of Heath's success equation. To assemble kits from most other manufacturers required (at the very least) that you be able to read a schematic—a bad marketing technique at best. Heath's philosophy was that anyone—given clear enough instructions—could put a kit together. The time, money, and effort Heath put into its manuals was well spent. Over the years Heath's manuals became as famous as its kits and made Heath the only serious player in the kit market.

Now I won't stand up here and say that the DX-100 put E. F. Johnson and company out of the ham radio business, but

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An AM Rig for 160 & 75

by Bob Dennison, W2HBE
82 Virginia Ave.
Westmont, NJ 08108

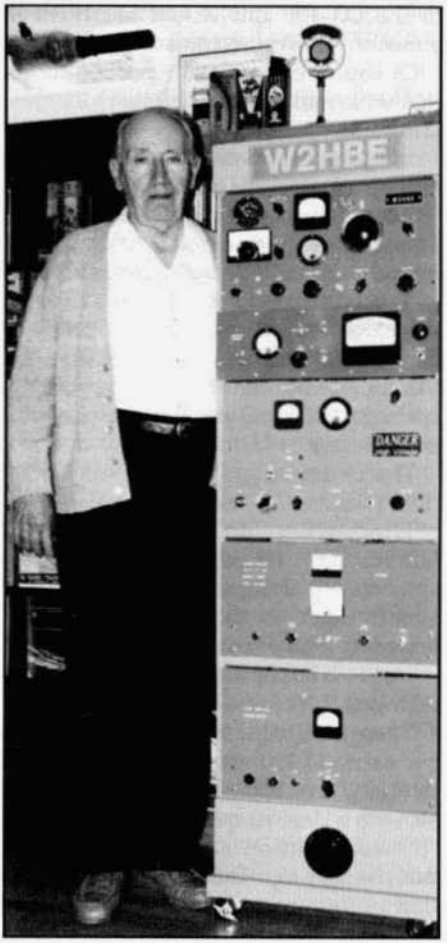
In 1988 I built a 35-watt AM rig so I could talk to my friend Jack. I am limited by a 67' Marconi so we often had trouble communicating, especially in summer when static was bad. About that time a man in my Sunday School class gave me a husky modulation transformer. I then began to collect parts for a better transmitter. During the preliminary design phase, I discovered that if I used 811-As for the modulator and an 813 in the final, I could use the same voltage on both the modulator and the final and thus eliminate one power supply. This would reduce cost, size and weight.

Parts - Where Do You Get Them?

Many parts were found at hamfests and flea markets. Some came from local hams and people who advertised in *ER* or *QST*. Some fellows were very generous and kindly gave me parts, refusing to take money. In particular, Parker, W1YG, gave me a driver transformer, the final tank condenser and the 200- watt bleeder! I found several sheets of aluminum in the flea market and K3IWK supplied parts from which the chassis were fabricated. I bought a pop-rivet tool to speed assembly of the chassis and an electric screw driver to reduce the labor in assembling the transmitter cabinet, which is made of wood. The block diagram, Fig. 1, is mostly conventional so I will comment only on a few of the special circuits.

The RF Unit

The VFO employs a 6AC7 in a Clapp oscillator circuit, tuned by a 3-gang (5.5-22pF) ball-bearing variable condenser. One section is used on 80M and two in parallel on 160M. The coils and tuning condenser are housed in a 5x6x9 inch box.



The driver uses a 6AG7 and its screen voltage is varied by the DRIVE control. To insure stability, the 813 final is inductively neutralized. Its screen is fed from the low-voltage power supply through a 12-henry choke which is shorted out in the CW mode. The screen is biased -70V in the Driver Tune mode. A special screen protection circuit is located in the low-voltage power supply and will be discussed later. A small muffin fan is used to cool the 813. The 813 tank circuit is a pi

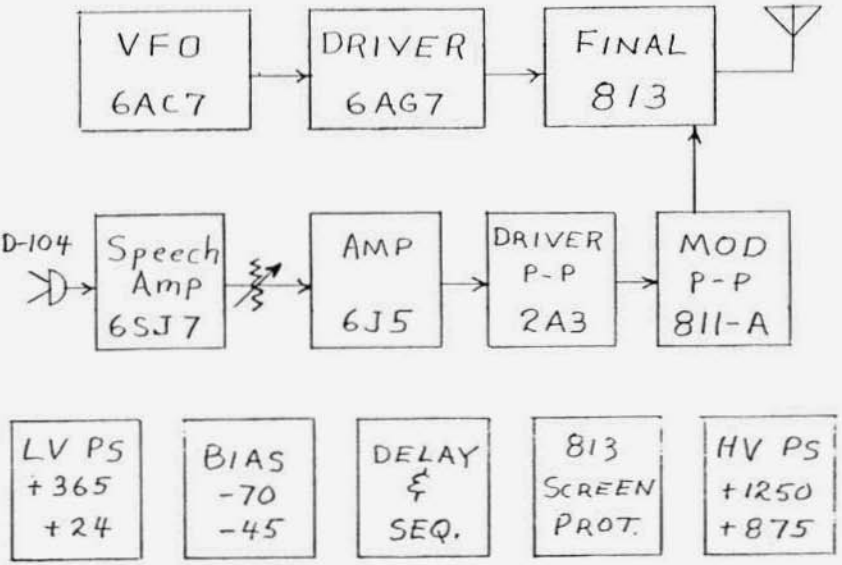


Figure 1. Block diagram of 200-watt AM transmitter.

network designed to work into a 50-ohm load. An antenna switching relay is also in the RF unit and its operation will be discussed later. The antenna tuner (not part of the transmitter) is based on the design article by WØLOB in *ER* No. 18, Oct. 1990.

Modulation Monitor

A modulation monitor is built into the transmitter. This unit is similar to the one I described in *ER* Nos. 10 & 12, Feb. & Apr. 1990 except that it contains a relay connected to the HI-LO power switch. Thus the carrier level is automatically set to the proper range when power is changed. A large VU meter was modified to indicate percentage modulation.

Modulator Unit

I was a little hesitant about putting all the audio circuits on a single chassis. Careful layout and decoupling are called for. The ground connections are not made to the chassis but to a heavy bus that is grounded to the chassis at one end only. The microphone jack is insulated from the chassis and grounded to the low-level end of this bus. A switch is provided to allow reversing the polarity of the audio signal to take advantage of the non-symmetry of the human voice - again refer to the articles in *ER* Nos. 10 & 12. A meter and 3-position switch allows me to read the plate current of either 2A3 driver tube or the total drawn by both. Two dual potentiometers are provided. One is arranged so that it increases the bias on one tube while simultaneously decreasing the bias on the other. The other control changes the bias (up or down) on both tubes simultaneously. Test points allow me to measure the individual biases. Thus I can quickly test a batch of 2A3's and divide them into matched pairs. A spark gap is connected across the secondary of the modulation transformer to protect it - see *ER* No.25, May, 1991. The AM/CW switch shorts the secondary of the modulation transformer in the CW position. A separate section of this switch connects the key into the VFO/Driver control line in the CW mode.

A small fraction of the audio from the modulation transformer is fed to tip jacks on the front panel for use in observing

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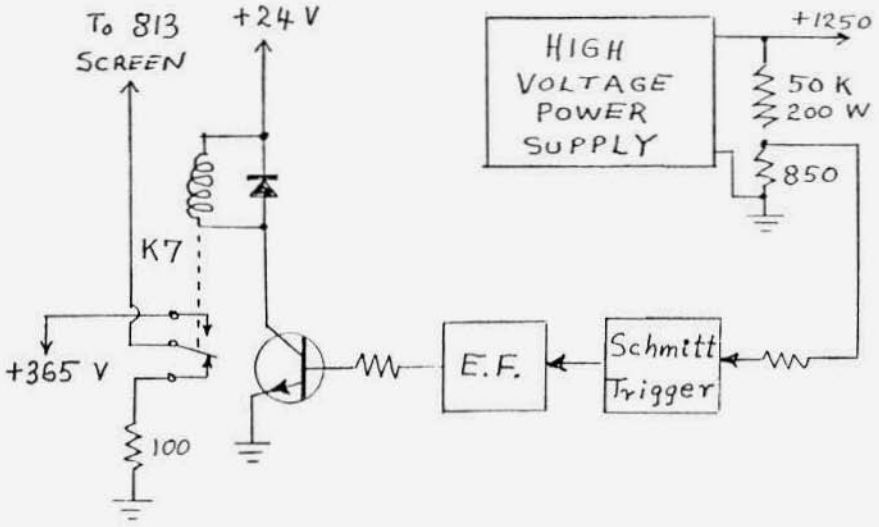

Figure 2. Screen protection circuit, simplified.

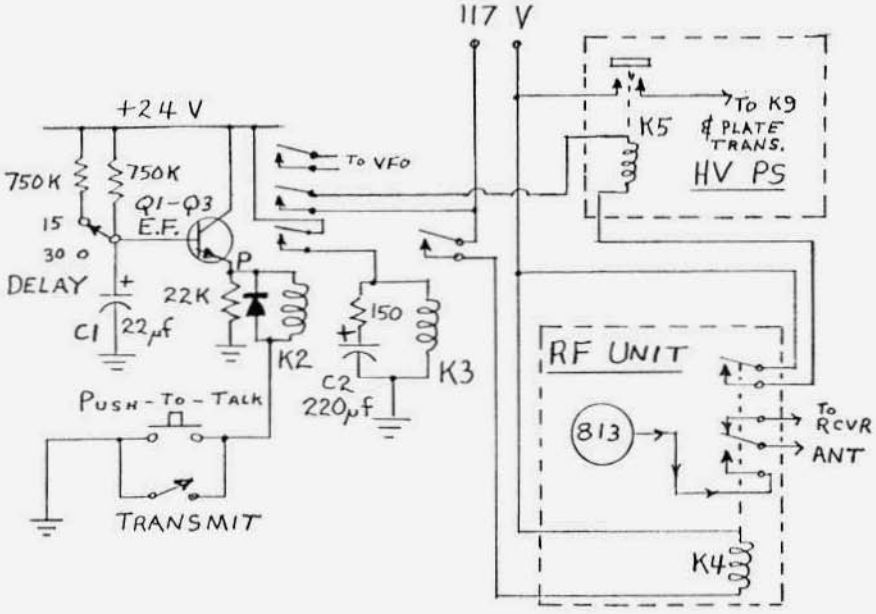

Figure 3. Time delay and power sequencing circuits, simplified.

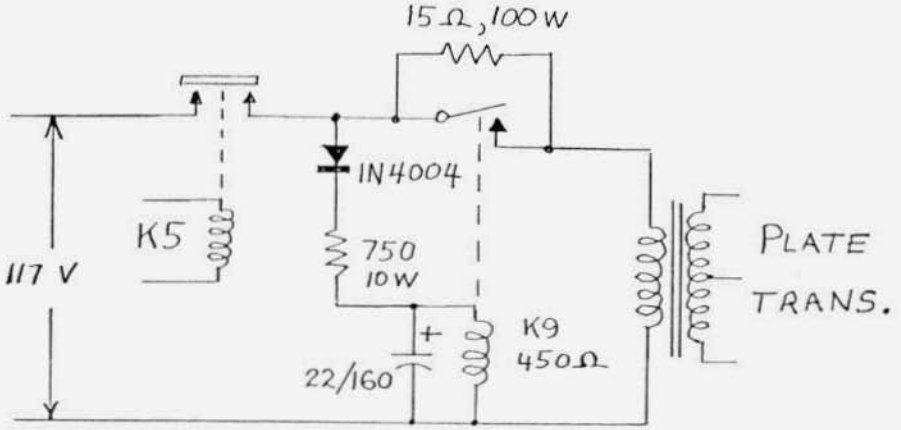

Figure 4. Current surge-limiting circuit.

oscilloscope patterns during testing and when calibrating the modulation monitor. A jack is provided for connecting an audio oscillator into the 6J5 amplifier stage for test purposes.

Low-Voltage Power Supply & Misc. Circuits

The low-voltage power supply delivers 365 volts. It uses a Stanley S-P243 transformer giving 900 V CT @ 250 mA. This transformer was obtained from Fair Radio Sales in Lima, OH. The full-wave rectifier employs six 2.5A/1000 PIV silicon diodes. A two-section choke-input filter is used with the 2A3 driver stage connected to the tap between sections. All ac for the transmitter passes through this chassis and is controlled by the MAIN FIL switch. The ac line cord first passes through a Filtron RF interference filter.

The bias supply uses a 65 V transformer and a bridge rectifier to give -70 V bias for the 813. Bias is regulated by several zener diodes connected in series. A tap gives -45 V for the screen protection circuit and the driver bias circuit.

The 813 screen protection circuit is designed to protect the 813 against those malfunctions which would cause loss of high voltage. The basic circuit is shown in Fig. 2 and uses four transistors and a relay. Plate voltage must exceed 450 V before the screen voltage is applied.

A 24-volt power supply provides power for various relays, the 813 screen protection circuit and the time delay and relay sequencing circuits. The latter circuitry is shown somewhat simplified in Fig. 3. When the filaments are turned on (Main power switch), the 24-V power supply begins to charge C1. After 15/30 seconds, the voltage at P has risen high enough to close relay K2 but, of course, this won't happen until we operate the Push-to-Talk (P-T) switch on the microphone or the "Transmit" switch on the modulator front panel. When K2 closes, it energizes K3 which closes almost instantly and this applies 117 V to K4 - the antenna changeover relay. A second set of contacts on K4 closes the circuit to the coil of K5 and the high-voltage power supply is turned on. Thus the HV is not applied to the 813 until the antenna is first connected. When the P-T button is released, K2 opens the circuit to the coil of K5 and the HV is turned off. A second set of contacts on K2 disconnects power to the coil of K3. But because of C2, K3 is slightly slow in opening. When is does open, K4 is deenergized

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AM International Update

by Dale Gagnon, KW1I, Interim President

AMI will be formally announced at the Dayton HAMvention on April 24, 1993.

AMI is a worldwide organization of amateurs interested in the enjoyment, promotion and preservation of the use of AM phone on amateur radio frequencies. AMI will be led by a President aided by a Vice President and Treasurer. These officers and a group of seven Regional Directors will form the governing Board of Directors. The eight AMI regions are marked on the map below. All officers and directors currently in place are volunteers and are serving in an interim capacity. Nominations and elections will be held in the fall so that elected officers and directors will be in place as of January 1, 1994.

AM enthusiasts the world over are encouraged to join AMI by sending $2 (U.S.) to receive an attractive AMI certificate, brochure, copy of AMI by-laws and list of officers and directors. Groups of amateurs interested in AM in other parts of the world are encouraged to become self-governing affiliates with AM International and to stimulate AM activity in their regions. AMI News will be published in Electric Radio and the AM/Press Exchange. Financial reports will be published quarterly.

Much of AMI promotional, event and operating activity will be driven on a regional basis. Periodic AMI wide contests and operating events will be announced in AMI News. (See page 34 for AMI's Armed Forces Day Military Radio Contest).

Your ideas are always welcome at AMI Headquarters. If you want to be more involved, contact your Regional Director.
AM International's new address:

AM International
Box 1500
Merrimack, NH 03054-1500

Interim AMI Officers

Dale Gagnon, KW1I, President
Warren Ziegler, NY2H, Treasurer
Bill Neeley, K7INK, S.W. Dir.
Bill Kleronomos, KDØHG, Rky.Mtn. Dir.
Pat Person,K7YIR, N.W. Dir.
Andy Anderson, N5JBT, S.Central Dir.
Andy Howard, WA4KCY, S.E. Dir.
Stephen Ickes, WB3HUZ, N.E. Dir.
Skip Green, K7YOO, N.Central Dir.
Tim Metro,WB8UHZ, Great Lakes Dir.

AM FREQUENCIES

2 Meters - 144.4, calling freq., activity in most cities; **6 meters** - 50.4 calling freq. **10 meters** - 29.0-29.2 operating window; **12 meters** - 24.985 calling freq.; **15 meters** - 21.400 - 21.450; **17 meters** - 18.150 calling freq.; **20 meters** - 14.286 for the nightly net starting at 5:00 CA time; **40 meters** - 7160, 7195, 7290 are the main freqs. Westcoast AM'ers net every Sunday afternoon, 4:00 PM on 7160; **80 meters** - 3870, 3880 and 3885 are the main freqs. Westcoast swap net Wednesdays nights, 9:00 PM on 3870. AM Swap net Thursday nights, 7:30 PM on 3885; **160 meters** - Gray Hair net every Tuesday at 8:00 PM EST on 1945. Mostly sporadic summertime activity, but during the winter signals can be heard anywhere on this band.

From the Editor:

U.S./Far East Net Proposed

[From a letter, recently received, from Stan Tajima]

"I am one of the very few hams in Japan who enjoys AM. I am hoping to establish an AM net between the U.S. and JA. I believe this will encourage more hams to enjoy AM.

"I know that AM activity on the westcoast of the U.S. is very high. Dennis, KØEOO and I have proven that a Valiant or a rig with equivalent power is enough for trans-Pacific communications. The best time is late afternoon or early evening.

"If you are interested in joining the effort to establish the U.S. and Far East Net, please write to Barry, KØEOO or me.

"I have been CQ'ing on 20 meters in the morning every weekend from Yokohama (using Ranger, Valiant or Lettine) but the reaction has not been satisfactory."

Stan Tajima, KD2HB/JA1DNQ
3124 Nasecho, Totsukaku,
Yokohama, Japan 245

Establishing a Presence on 15-Meters

[Recently received from Rob Brownstein, NS6V]

"Here's my suggestion for establishing a presence on 15-meter AM. From now on, when you establish an AM QSO on 10-meters, suggest to the other operator that you both QSY to 15 meters and carry on the QSO there. One operator should scope out the band from 21.390 and up, check for a clear channel, and call the other operator.

"This will accomplish several things: it will avoid the frustration of unanswered CQs on 15; it will attract other AM'ers who now bypass 15 because they hear no activity; and it will put an AM stake in the ground, so that when 10 meters is dormant, we will not suddenly emerge on 15 from out of the blue.

"I am going to do this routinely. I hope other AM'ers will do likewise. There are too many talking about the lack of activity on 15 while "chewing the rag" on 10."

Rob Brownstein, NS6V

How About WAS Awards?

It's been suggested to me that it might be worthwhile to provide awards for WAS and DXCC, etc., using AM. I think it would be fun to get back into exchanging QSL cards and this would be a good reason to do it again. I'd like to hear comments from readers before I start working on the details. Please send me any thoughts you might have on this. **N6CSWØ**

The Vintage Electronic TR Switch

Is it for you?

by Dennis Petrich KØEOO
6419 Berwickshire Way
San Jose, CA 95120

I first came across the electronic TR switch in an early *QST* article back in the '60's. The article talked about "full CW 'break-in" or 'QSK' as they call it today. The thought of hearing the signal on the band while you were transmitting was exciting to me back then, and still is today. In those days I was all homebrew, so, I built my own TR switch and set up a full break-in station which I enjoyed for many years.

Well, it's March of 1991 and over the years I have managed to lose, sell or give away all of my homebrew equipment, thinking amateur radio was behind me. So, here I am in Japan with a business friend who is also a ham. We start reminiscing about the good old days and I start making a wish list of all the rigs I ever wanted as a kid. (Would you believe that today I have most of the rigs on that list!) Well, the talk with my friend got me realizing how much ham radio was a part of my soul. As luck would have it, his dad had a Signal/One CX7A for sale, one of the rigs on my list, the newest one in fact.

It's six months later now and I was on 40 meters ragchewing with Jack, KL7GKY. Jack and I started talking about old rigs and he asked me if I knew of *ER* magazine? I said, " no", and he said he would get me a copy from the publisher. Well, a few weeks later the July '91 issue arrived. I read it from cover to cover in one sitting, called Barry and ordered all of the back issues, which I also read from front to back. It was like the "The Call of the Wild". I was drawn back into vintage ham radio by a power I did not understand.

So, in a manner of speaking, I have Jack and Barry to blame for all of the money I've spent on dusty old iron, antennas shading the back yard and my shocked wife who never knew me as a "DX-chasing rag chewing junkie." Actually, I've loved every minute of this last two years, and besides, my wife has come out of shock and all is well even with the antennas.

So, as I started the story a few paragraphs back, here we are, it's 1991, I have 1958 equipment and I want to get back on CW with my first vintage setup, the CE100V (ER#30) and 75A-4 (ER#46). I'm using a Dow TR relay on the CE100V/600L for SSB and CW with it's LOUD 'Kerchunk', not very noticeable on AM but very annoying on VOX and CW. With the relay there was no CW break-in, which jogged my memory into remembering the electronic TR switch that I had built years ago. So, I started scanning the *ER* want ads until I found a B&W 381 TR switch down in Arizona. As expected it worked just fine, lots of gain on receive, no suckout noticed and what I really wanted, QUIET VOX operation and full CW break-in.

(You say "what in the world is "suckout"? Well suckout is when your final transmitter tank tuned circuit shunts to ground some of the receive signal when it is off resonance or not 50 ohms at the receive frequency. It's kind of like not tweaking your "antenna tune" knob on your receiver when you tune from the CW section to the AM section of 10 meters. Well, the transmitter tank circuit is like another tuned circuit to adjust in your receivers front end because with the electronic TR switch the two are now in parallel.)

Electronic TR switches, the B&W model 381 on the left and the E.F. Johnson 250-39 on the right.

To set up one of your vintage stations with an electronic TR switch this is all you have to do:

1. Connect up the TR switch in place of your present relay. Use a piece of coax around 3 to 4 feet long to connect the switch to your transmitter.

2. Connect your transmitters spare VOX or TR relay contacts to break the receiver's speaker connections or use some other means for quiet muting of the receiver as recommended by the manufacturer.

With this easy hookup you will have quiet, fast VOX operation with full speaker muting and on CW the speaker will give you your CW tone for monitoring your signal and frequency. I believe all of the vintage SSB/CW/AM linear transmitters had a mode that would allow you to key up the transmitter without keying up the VOX relay. This mode is specifically for CW breakin operation. The CE100V, 600L, Johnson Invader 2000 (ER#45) and Valiant are set up in such a way.

The electronic TR switch came about to provide what we just talked about, fast antenna switchover for CW breakin and later on, VOX operation for SSB. Relay contacts will arc and burn out in such operation unless they are dry switched and time sequenced and even then because relays of this size are slow to switch (>20ms), only low powers could be achieved without too much time lag in the conversation. (Today, vacuum relays solve most of these problems by providing a faster relay where carbon will not form on the contacts due to the vacuum, thereby prolonging their life.)

The electronic TR switch works as can be seen in Figure 1. During receive V1 & V2 act as a broad-band RF amplifier with V2's grid near ground potential, and when transmitting, RF from the antenna is filtered and used to cut off V2, thereby protecting your receivers front end. The circuit I've shown here is the EF Johnson 250-39 TR switch. I also have the

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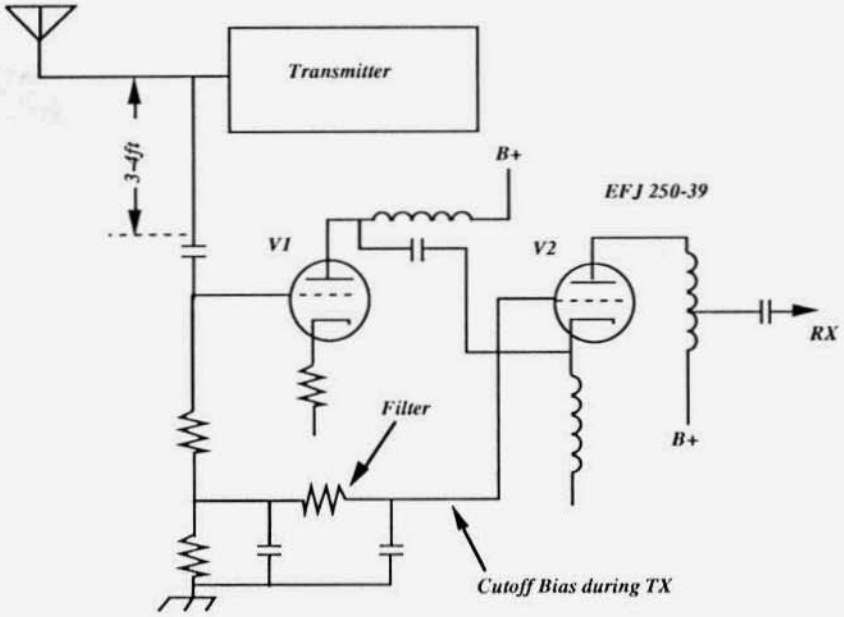

Figure 1.

aformentioned B&W 381 switch, which has a different circuit but accomplishes the same protection and uses a band switch instead of broad banding to select 80 to 10 meters. From an installation standpoint the B&W has band switching, which means it must be accessible to the operator to switch bands, meaning you can't physically tuck it away and forget it like you can the 250-39, a feature I like.

Both TR switches provide gain to overcome "suckout" by the transmitter's output coupling circuits. (Earlier designs by DOW and E.F. Johnson only had a single stage which provided no gain. These units were susceptible to suckout.) In fact, in all cases, both TR switches provide several dB of gain on all bands. Also, the noise figure of the two units I have, ran from 2 to 13 dB depending on the band selected (see Figure 2). Also, the 250-39 TR switch on the Invader 2000 and NC-303 was not affected by a very, very strong local SSB signal from a neighboring ham one afternoon on 20 meters. I could copy weak stations as close as 10 kcs away (the IF BW at 60 dB on the '303) and in a scan of the band I heard no overload effects.

Noise Figures in dB.

BAND	B&W 381	EFJ 250-39
80	11.0	12.9
40	10.0	12.6
20	4.5	2.0
15	8.7	4.4
10	5.0	3.0

Figure 2

The next chart is a comparison I have not seen before in any other literature (see Figure 3); that of the receiver and TR switch together. Notice the effect the TR switch has on receiver front end sensitivity. In my tests I saw negligible effects by the addition of the TR switch to the circuit. By the way, the receiver used for this test was the HRO-5 RA1.

Input sensitivity in microvolts at 10 dB SNR, AM mode.

BAND	'381	'250-39	RCVR alone
80	.35	.34	.29
40	.30	.31	.22
20	.55	.49	.55
15	.45	.44	.28
10	.80	.75	.90

Figure 3

The first tube in each of the TR switch designs is selected for its high grid-to-cathode voltage rating. As an example, the 6S4A in the B&W 381 can withstand 570 volts. Both units are rated at 4 to 5 KW at a 1:1 SWR and 1 KW at a 4:1 SWR. SWR is important here because the higher the SWR the higher the voltage at the grid of V1. For example, a KW AM rig would place 400 volts rms at V1's grid at a 1:1 SWR and 750 volts rms at 4:1 SWR, too much of course. So a 2:1 SWR is the highest SWR the '381 can withstand at 1 KW output. The B&W 381 manual included some curves about the safe ratings of their TR switch. See Graph 1.

What this is all leading up to is whether one can benefit from the use of a TR switch. Well, there are at least seven factors to be considered when comparing a TR switch to a traditional TR relay.

Item	TR switch	Relay
1. Noise figure	2 to 13 dB	0 dB
2. Intermod dist.	not meas.	RX front end
3. Gain above noise	2 to 9 dB	insertion loss
4. Switching speed	instant	>20 ms
5. Acoustical noise	none	'Kerchunk'
6. TVI filter required	Yes	No
7. Amp. cutoff bias	Yes	No

Because the grid of V1 is driven positive during transmission, TVI harmonics can be generated and radiated by the antenna. Both B&W and E.F. Johnson recommend a low-pass filter be installed in the line; something all of us already have I'm sure.

Also, because the receiver is connected to the transmitter tank/final amplifier while the transmitter is cut off or not transmitting, the finals must have enough cutoff bias to eliminate any 'hash' from being generated by the transmitter; such hash will be heard by the receiver as white noise. The only way to tell for sure if you have a hash problem is to hook it up and listen. If you do hear some noise coming from the transmitter, just increase the cutoff bias to the finals. This problem occurs rarely; my CE100V, 600L and Invader 2000 were OK.

Well at this point let's try to draw some conclusions, if you haven't already. For CW breakin and VOX SSB stations the TR

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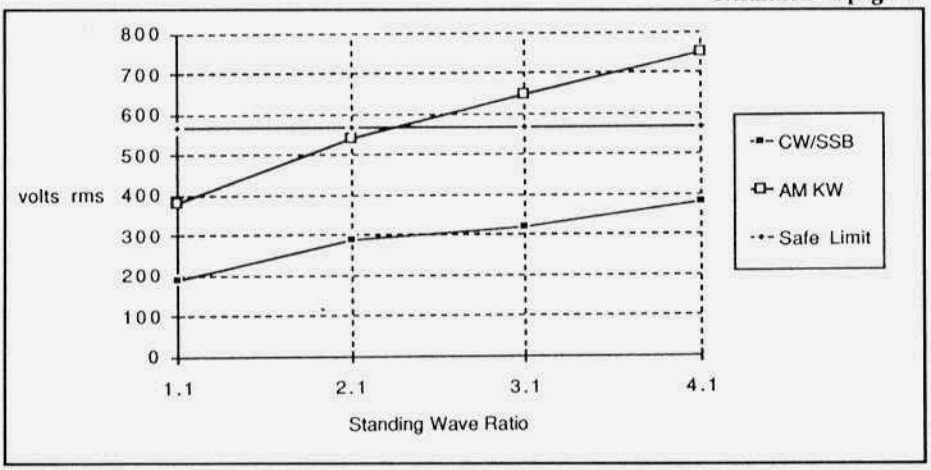

Graph 1.

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Photographs of Hams

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District #5: WD5BPP - #37, K1SDT - #47, WB5HRI - #37, WB5OAU - #39, N5QVQ - #37, NK5T - #44, N5SWO - #47, W5TQO - #39,

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District #0: N6CSW/Ø - #42, #46, KDØHC - #37, KØEOO - #48, WØGFQ - #48, WBØLXV - #38, WØOGH - #46, KØPVI - #44

Other Districts: DJ7HS - #38, JI1IRC - #39, JA1FFX - #39, JA1EIA - #39, JA1DNQ/KD2HB - #39, JA6IBX - #41, VE2MUX - #44, VK2ZTM - #39,

Aligning the NC-303 ("Son Of Dream") Receiver

by Rob Brownstein, NS6V
3881 Winkle Ave.
Santa Cruz, CA 95065

Remember the famous "Dream Receiver" campaign of 1955 where National claimed to have built a receiver based on a wish list compiled from a poll of active ham radio operators? The receiver National built was the NC-300. That's why I call the NC-303, which followed in 1958, the "son of dream" receiver.

I got my NC-303 about a year ago, hooked it up, plugged it in, and used it, as is, until I finally got a signal generator with a range below 100 KHz. Lots of these receivers have sub-100 KHz IF sections, and if I was going to align it, I wanted to do it right.

When I bought the receiver, I got an original manual — it even had a former owner's name in it. It seemed reasonably complete, at the time, and after a quick read, I put it in the user's manual file. Now, in preparation for the alignment, I pulled it out again. It had a section on maintenance (section 4), which I began reading through. There were references to coils, transformers, capacitors, test input points, but lo and behold, the manual had no diagrams or pictures to go along with those references.

"Where were T8, and C70 and C68C," I wondered? In that poll that National had taken, did a lot of hams request that National leave out diagrams and pictures in the manual so that we would have to treat working on the receiver as if working on a "Where's Waldo?" puzzle? It seemed so.

So, there I was, schematic in hand, working my way through the multi-multi-section band switch trying to correlate physical components with schematic references. Just to make things more challenging, National arranged the high-end RF adjust capacitors and companion transformers in less than a logical order (see my diagram). At least the trimmer capacitors are arranged in order. Note, too, the strange order of the coils in the 80 KHz IF section (L's 5,7,9,10,12, and 13).

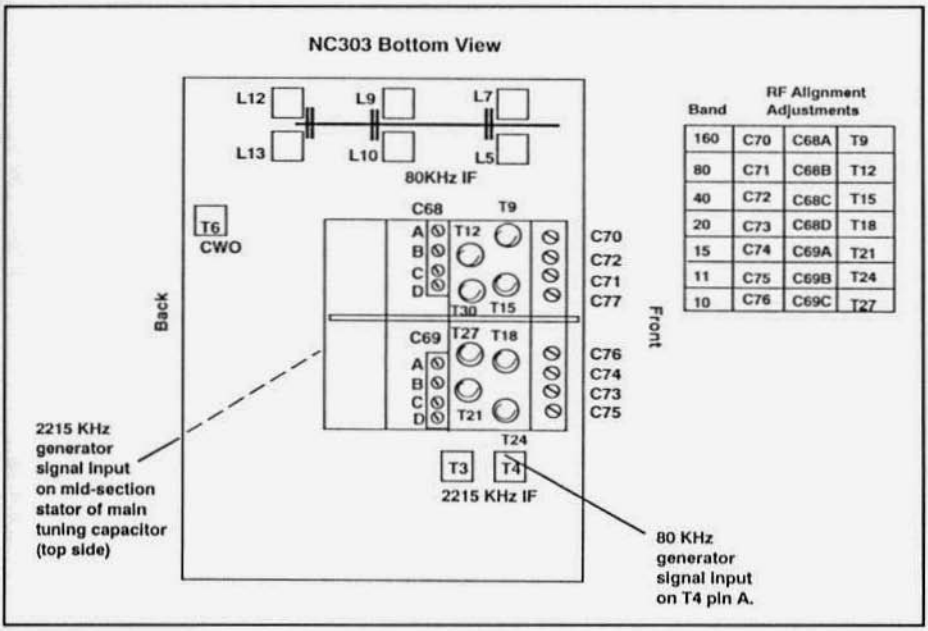
Once you've taken the time to trace the switch and wiring and identify the appropriate adjustment components, going through the process is fairly straightforward. Except, that is, for the two errors in the manual. On page 13, section 4.2 (8), the last sentence asks you to adjust T8 for zero beat, etc. However, T8 has nothing to do with the CW oscillator, nor is it an adjustable component. The transformer they want you to adjust is T6!

On that same page, section 4.3, they ask you to adjust the four slugs on IF transformers T2 and T3. Wrong, again. It should be T3 and T4. (Okay, everyone is entitled to make a mistake.)

The alignment procedure begins with putting an unmodulated RF generator signal between T4 pin A and ground. The generator should be set at exactly 80 KHz. I used a frequency counter in addition to my HP-606A. Adjust the generator's output and the receiver's RF gain to keep signal levels at about S5 on the S-meter. Then, in order, adjust L's 13, 12, 10, 9, 7 and 5 for maximum signal level with the receiver in AM mode, selectivity in position S, noise limiter off, Q multiplier off, and antenna trimmer at the index mark. I suggest repeating the adjustments a second time; I found a little interaction.

With the IF section adjusted, put the receiver in CW mode, the CWO control at the index, and tune the slug in T6 for zero beat. Next, put the receiver in SSB mode (so you can read the meter) and adjust the slug on the Q multiplier for minimum signal.

That done, remove the signal generator from T4, and put the signal into the center-section stator of the main tuning capacitor. The ground lead goes to chassis. Return the receiver to AM mode with the



Q multiplier off. Vary the generator's frequency slightly until you get a peak signal on the S meter. Again, back off the RF gain, if necessary, to keep signal levels to about S5. Adjust the slugs on T3 and T4 for maximum output on the S meter.

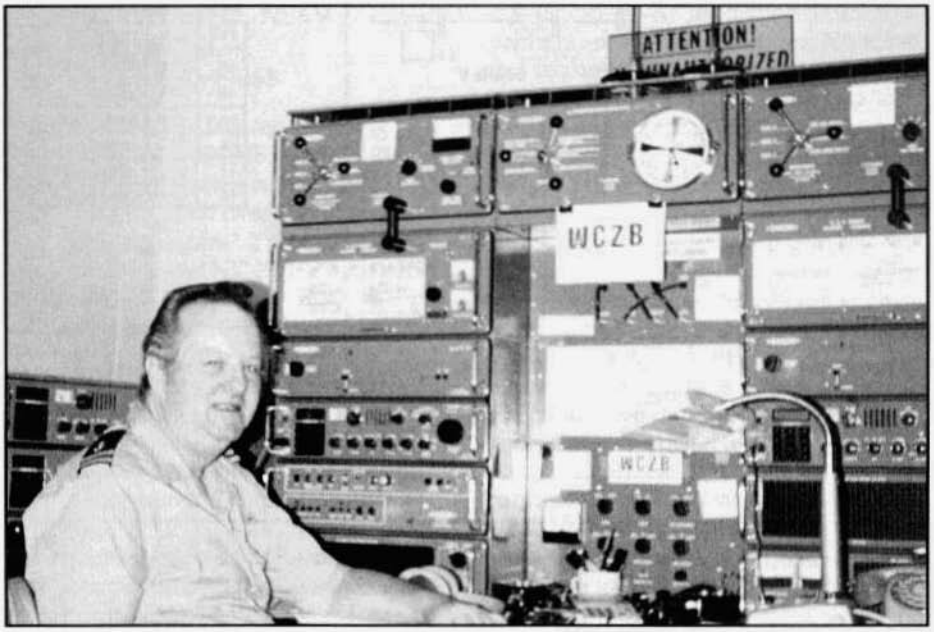
That completes the alignment of the two IF stages. The RF input stage has no adjustable transformers. If your receiver's frequency alignment seems close (e.g. within the range of the "cal set" offset), you should stop right here and save yourself a lot of frustration. On the other hand, if your calibration is way off on some bands (mine was off as much as 20 KHz on 20 meters), then you are in for some fun (not really).

There is a table in the manual on page 14 that tells you what frequencies to set your generator at, and what adjustments to make. The generator is connected to the receiver's antenna input terminal through a series 70-ohm resistor. Starting with 160 meters, you first set the receiver's dial to 2.0 MHz, the generator's signal to 2.0 MHz, and you adjust C70 for maximum signal (selectivity at 'S' position, still). Next, you move both generator and dial point to 1.9 MHz and adjust trimmer C68A for maximum signal. Finally, you adjust both generator and dial to 1.8 MHz and pray a lot that the two are close. (Mine weren't). If you find the dial is off at 1.8 MHz, look inside the ceramic core of T9 and notice a little wire (or pair of wires) looped inside. These are your adjustments (no, I'm not kidding). Using a rigid plastic rod, move the loop inside the core toward one side or the other. [Note: It takes very little movement to swing the frequency in big jumps.] Once you've played with the wire loop and gotten your 1.8 MHz signal at 1.8 on the dial, go back to the 2.0 MHz dial setting, reset your generator for 2.0 MHz, and discover that the two are not in sync anymore.

You will come to find that when you adjust the high-end frequency component, it moves the low end, and vice versa. You can cheat a little by seeing which direction they pull one another and anticipate the shift in each successive repeat procedure. I never quite got my 10 meter band to line up at both ends, but I did get very linear results on all the other bands. It also took a long time!

continued on page 31

LETTERS



David Olsen, W6PSS, radio operator on board the largest U.S. flagged vessel, the Bridgeton

Dear ER

Hello from Asry Shipyard Bahrain. .

On the largest US flagged vessel named Bridgeton. She's a huge tub - 1200 ft in length, and 250 ft wide. Takes 45,000 shaft horsepower to push her and her crude cargo thru the briny at a cruising speed of 12 knots. Fully loaded displacement is 470,000 tons with 3,000,000 barrel cargo. The radio operator maintains 8-hour 500 kHz watch and handles most traffic via International Maritime Satellite (INMARSAT). I'll leave out further details but you can glean some from the photograph of the shack - which I have included.

Although I'm currently QRT, had a ball working AM hams enroute from Houston to the Atlantic via the Caribbean. Lost reliability about mid-Atlantic enroute to Med. And Suez transit to Red Sea to Arabian Sea to Pursian Gulf proved nil. But, not to feel bad, duties keep me busy 10 to 12 or more hours per day. Not much, if any, time for what creatures like us enjoy - AM!

AM Stations logged by W6PSS/MM between 20 Dec and 3 Jan '93:

75M N5FZ Mike, K8MLV/Ø Rick, W3DUQ Bill, KA3OMZ Ron, KB2URH Sue (Sweet Sue), WA1HLR/M "Henry Yell R Radio" Tim, WA1SOV Pete, K4KYV Don (AM Press Exchange Ed.) and several others. Went bonkers when I heard Don and lost my log sheet of the others - sri.

20M KW1I Dale & Son, K6HQI Les (Congenial host 14.286 Net), KDØMK Nate, N5JBT Andy, NJ6L Keven, K8BZZ Ned, W6HDU Sam (West Coast 75-M flagship station) and KEØYAB John.

10M WA8MRE Harold (Sometime AM Mag. Ed.), WC7O "Oro Bill." W1KNH (lost), K2DSO Joe, WDØCZY Bill, K2OL

Joe, VE3OHC Dave, *WA6ZJC John (Of "Westcoast Audio" fame), *K1GUP Jerry, *WB5UGT Steve, *K9IUF Bill, *KB5HII Barbara XYL of WB5UGT, *K7CMS "Tucson Bill," *KD6OS Ralph, *WD6FGF Al, *KI5DT Don, *N3HEK Dave, KD4NQX Jerry, WBØIRU Ken, K1MFW Bob and A1RWH RJ.

Asterisk indicates ER sponsored 160/10M Contest/Jamboree

It is indeed difficult to express the joy and excitement that one experiences when working amateur radio friends from a ship at sea. I'm grateful for that opportunity, and I thank God for these friends.
David Olson, W6PSS

Dear ER

There is an interesting footnote to Part 4 of the NØDMS article on the Collins 75A receivers. Some years back, I picked up a quite clean 75A-3 from a fellow in Piqua, Ohio. As soon as I got it home, I noticed that the usual Collins winged emblem was missing from over the main slide rule dial. In its place was a curious small knob with a plate mounted behind it. It turned out to be passband tuning control. Upon doing some detective work behind the panel, I discovered a combination passband tuning/product detector circuit mounted on end in a narrow Bud-type aluminum box which had an octal socket mounted on one of it's ends. The device, manufactured by Universal Service (now Universal Amateur Radio) of Columbus, Ohio, was plugged into the NBFM socket at the rear center of the 75A-3 chassis. It had a long shaft extending to the front panel control which had replaced the Collins emblem. Obviously, this was a clever circuit which did little to lessen the value of the receiver for resale. One simply had to unplug the minibox,remove the shaft and it's knob and replace the original Collins emblem. To use the unit, the front panel mode switch was turned to its NBFM position. The original BFO is still available for use by switching to the CW position.

After spending a few evenings using the modified 75A-3, it would be difficult to rationalize the use of the receiver in its original form. While the 75A-3 was a good performer on AM (with the appropriate filter installed),its performance for CW and SSB leaves a lot to be desired. Unless the RF gain is ridden, considerable distortion is noticed. With the Universal Service device is in use, the receiver can be favorably compared to the 75A-3. I have no schematic for the little modification nor do I have any idea just how many of the units were manufactured. Perhaps another of your readers can add more to this story.

I enjoy the publication and look forward to its arrival each month. I may be 8,000 miles away from the U.S. but the collecting/restoring fever dies hard and I don't seem to be able to free myself from it no matter how far away I am.
Dave Heil, A22MN (K8MN)
Gaborone, Botswana

Dear ER

Jim, W4PNM, Hank, W2IQ, and myself will be going to Dayton will be in the boneyard in spaces 4211 and 4212. I invite everyone to stop by and say hello. A lot of AMers I know but would like the opportunity to meet some of the ones that I have not met personally. I sure hope the weather is better this year.

At a recent hamfest at Dalton, Georgia, there were 36 AM operators in attendance. (See enclosed list). Of this 36 there were 26 in attendance at an AM luncheon. This is an annual event and is usually well attended. Since Dalton is the first hamfest to be held in this part of the country we can always count on the AM community to be well represented. Just thought that you would like to know that AM is alive and well in this area. By the way, there are now 7 AM operators in the Carrollton area. We must be doint something right to attract so many people who are interested in the mode.

continued on page 34

ER Bookstore Review

"Oscilloscopes
Selecting And Restoring A Classic"
by Stan Griffiths, W7NI

Reviewed by Ray Osterwald, NØDMS

People tend to take things for granted after a certain period of time. Behind every successful company is an original design principle, and in many cases this was the result of one person who essentially worked alone. After the years go by an entire industry evolves, patents expire, and the design principles become public. Today, nobody would undertake serious design or troubleshooting of complicated equipment without a triggered-sweep oscilloscope. This is so basic that we forget there was a time when such an instrument did not even exist. If it had not been for a young engineering student named Howard Vollum, who built the first oscilloscope using a calibrated timebase in his parents' basement, progress in electronics would not have come so far, and so fast. Mr. Vollum took his scientific experiment, and with the aid of some of his friends and several tons of war surplus components, began producing Tektronix oscilloscopes in a vacant garage.]

I thoroughly enjoyed Stan Griffiths' book. I keep my copy handy, and learn a little more each time I read it. Mr. Griffiths spent many years working at Tektronix, and the contents of his book are not available from any other source. As I see it, there will be two main groups of readers who will need to get a copy of the guide. The first group will be those who already have early Tektronix equipment, and need to properly maintain it. The other group would be those who are about to purchase some of this classic instrumentation and need a clear, concise guide to the available features.

The book begins with understandable descriptions of how an oscilloscope works, and is further broken down into 5 major sub-systems: the CRT, vertical deflection, the timebase, triggers, and the power supplies.

Chapter 2 is equally invaluable in that Stan gives procedures for determining an instrument's condition before purchase. This section was written for the swap meet buyer, and no special test equipment is required to make fairly detailed checks.

Chapter 3 goes into cleaning procedures, a vital step in the restoration of any lab-quality equipment. Everything you would need to know is well presented. This includes what soaps and solvents to use, how to rinse, special precautions, re-lubrication and even includes detailed instructions for building a drying oven, made from an old refrigerator.

Chapter 4 has electrical restoration instructions. What is presented here is all of the secrets a Tektronix technician would have used during the course of a normal overhaul twenty years ago. This section alone makes the book worth the modest price.

The balance of the book details 267 different vintage Tektronix oscilloscopes and associated plug-in units. Each one has a sharp factory photo and a brief, but well detailed description.

W7NI concludes with a glossary, a list of substitute CRTs, solid state rectifier info, and parts sources.

The only weak spot is his price guide. I think he has underestimated what this equipment is currently fetching. Not only is it worth a lot as quality test equipment, but Tektronix equipment has suddenly become collectible. I've seen recent ads for pristine 540-series scopes with a 4-figure price!

I would recommend this book to anyone who is interested in using vintage Tektronix gear. Who knows, perhaps there will soon be a Tektronix users' group on 20 phone!

The book is available from the *ER*. See page 40 for more information.

switch has many advantages, and if that same station has AM plate modulation capability such as the B&W 5100 or Valiant II then the TR switch can withstand the modulation peaks just fine. But, for strictly AM stations the TR switch doesn't offer much because the normal mode of operation is the long monolog and fast antenna switching isn't necessary. In this case a relay is fine.

I use the TR switch on my CE100V/600L/75A-4 and Invader 2000/NC-303 stations and relays on my AM stations for the above mentioned reasons.

At this point I'd like to provide some appendix information. First, there are three very good articles I came across in doing the research on TR switches. One is in *QST*, May of '56, p.23, by W1CUT. Another is in *QST*, Sept of '58, p.46, Product Review on the EFJ 250-39. Finally, the last article is in *CQ*, Feb. of '64, p.40, *CQ* Review of the B&W 381.

The '56 *QST* article was interesting but be careful if you read it. Much work was done by W1CUT to define and measure receiver suckout. He made one assumption that doesn't really hold true today, at least not in my shack. He assumed you would tune up your transmitter at one frequency and then receive and transmit on the entire band without retuning. Well, suckout is not a problem near the resonance of the tank of the transmitter, +/- 200 kcs on 10 meters, but is a problem the further away from the tuneup frequency you stray. I usually stay within +/- 50 kcs of the transmitter frequency.

But, with the CE100V and CE600L amplifier, which have broad-banded couplers for output tanks, I can tune the entire band with no suckout effects! This is 1955 technology for you!! Also, the TR switch W1CUT used was an early model with less than unity gain (gain less than one). The problem of suckout in these early TR switches prompted the design of switches with some gain to overcome the interaction of the final tank circuit and the TR switch. Also, be aware that the length of coax between the transmitter and the TR switch is somewhat critical. Keep it to about 3 to 4 feet and you shouldn't have any problems. The two TR switches I discuss here have gain to overcome suckout.

The *CQ* article about the '381 was also very informative and provided more useful information about TR switches for today's operating practices. Read both of these and let me know what you think.

To summarize, I want to say the performance of the '250-39 and '381 switches with my Invader 2000 Pi-net output tank and the CE100V and 600L amplifier with broad-banded couplers has been excellent. There is no way I'd go back to the 'Kerchunk' on VOX and CW again. The noise figure of both switches is quite acceptable for the CW and SSB DXing work I do. My belief is, if the DX is that weak, they probably won't hear me anyway. To date, I hear those solid-state stations with my hollow-state receiver long before they seem to hear me. **ER**

Editor's note: Thanks to Jim Lockwood KM6NK, for the photographs here and for those that accompanied the Invader 2000 article in issue #45. He uses a Nikkon camera with a 50mm macro-Nikkor flat-field lens, Kodacolor 100 ASA film and three slave strobe lights to take care of shadows.

Aligning the NC-303 from page 27

Several days after completing the alignment Don, KI5DT, sent me a copy of the NC-300 manual. For some reason, National thought it was a good idea, in that manual, to put in a bottom-view photo with the capacitors, coils and transformers suitably labeled. Why they elected to dispense with that useful information in the NC-303 manual shall remain a mystery. **ER**

Heath DX-100 from page 13

I will say I believe the DX-100 hastened their demise. By 1956 most of the big-name manufacturers including Hammerlund, Hallicrafters, RME, National, and others were in serious financial condition. These troubled times resulted variously from an inability or unwillingness to adapt to a new post-war business climate to a failure to see or understand the future direction of technology. Like the dinosaurs, they couldn't, wouldn't or didn't change quickly enough in a fast changing world. Heath survived and flourished partly because it was in the right place at the right time with the right idea, partly because it had a keen understanding of both the technology and the marketplace, and partly because it had a clear vision of the future—a vision that would carry it through four decades of success.

The DX-100 was more than just a successful rig. Ultimately, it gave Heath the financial power it needed to shift into high gear, permitting a rapid expansion into other amateur products and additional product lines. Exactly how successful the DX-100 was can be seen in Heath's advertising. Prior to the DX-100, Heath bought only small ads in *QST* focusing mostly on test equipment. But by 1956, less than a year after the DX-100 hit the market, Heath was buying 3 full pages of advertising in selected months of *QST*. In 1957 Heath expanded to four full pages. In 1958 Heath pulled out all the stops, buying five full pages in all 12 issues. That kind of advertising takes money—lots of it. But money bought more than just advertising—it bought "know how." Heath now had enough money to hire additional engineers—graduate engineers. Joe Schaffer, Al Robertson, and 10 others together with Roger Mace were given the job of expanding the amateur product line. And what's more, Heath had enough engineering muscle in this group to move out of the reverse engineering mode and into innovative products of their own design.

In the years that followed the DX-100, Heath would have many successful amateur products—some even more successful than the '100 itself. But because of what it was, when it happened, and what it did for Heath, I doubt that any Heathkit will be remembered more fondly—or by so many—than the DX-100. **ER**

SSB With the Airforce from page 3

I think it's important that we all support Leo in his efforts. It's important that the vintage equipment we all care about and the history of amateur radio be preserved for future generations. Some hams don't like the idea of any vintage gear being taken out of service for display purposes but they should be reminded that Leo only requires 1 piece of each type. It's not as if the amount of gear in service is going to be seriously depleted.

Please consider contributing something to the amateur radio display at Western Heritage. Remember any donations are tax deductible and they will remain at the museum permanently. **ER**

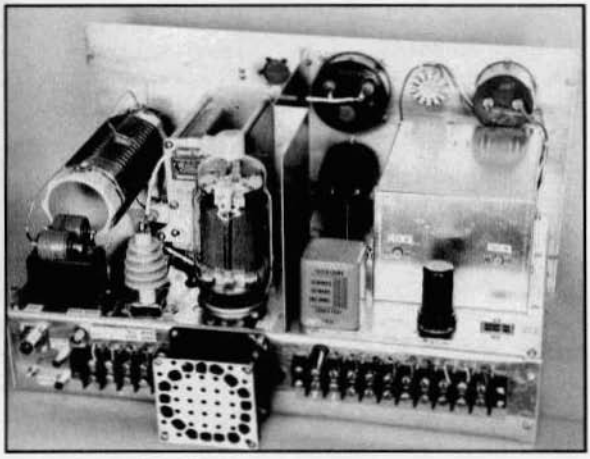
Letters from page 29

My latest project is a rather simple one. I have (as have lots of others) a regen receiver. Uses a 6J7 detector and a 6J5 audio amp. Looks and works great. Les and the west coast group come in very nicely on it. Also have been experimenting with some short wave crystal sets. (State of the art of course). Jim has constructed a low power CW rig and along with my regen set we will set up in the motel room on 40 meters. Hope that we can make some contacts. He may even build a modulator for it and we can try some AM phone.

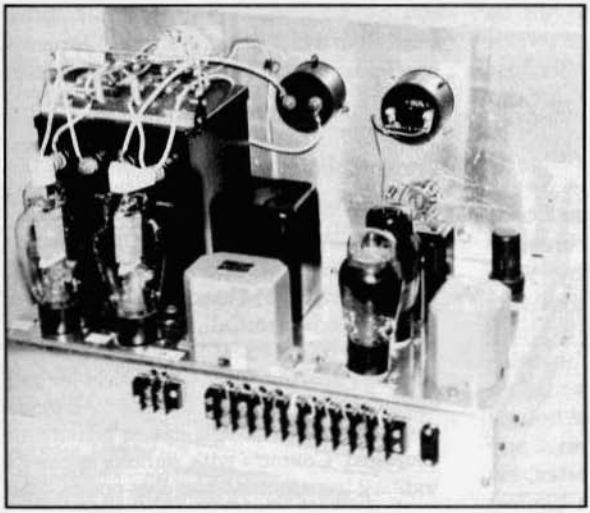
Andy Howard, WA4KCY

An AM Rig for 160 & 75 from page 17

and the antenna switches back to the receiver. Thus the HV is removed from the 813 before the antenna load is disconnected.



Rear view of RF deck.



Rear view of modulator deck.

Not shown in the diagram is relay K1, which shorts out C1 if the ac line voltage fails for more than a few moments. Thus a brief failure of the line voltage means that the timer must recycle and this ensures that the HV rectifier tubes will be hot before plate voltage is applied. While Q1-Q3 is shown as a single transistor, there are actually three emitter followers cascaded (Darlington circuit) to give high input resistance. Another set of contacts on K2 is used to turn on the VFO and driver and a third set of contacts on K4 is used to mute the receiver. Since these relays are located on three different chassis, it calls for a lot of cabling but the results and smoothness of operation are worth the effort.

High Voltage Power Source

A pair of 866A or 3B28 rectifiers are used in a full-wave circuit followed by a two-section choke-input filter for low hum level and good regulation. A 15-ohm resistor is inserted in series with the primary of the plate transformer to limit the initial surge current. This resistor is shorted out after about 0.2 second. The circuit is shown in Fig. 4. Not shown is the HI-LO power switch that switches in the Variac used to lower the primary voltage during low-power operation. Most of my QSOs are with a friend who lives only seven miles away so provision was made to reduce power to 80 watts. The HI-LO switch operates a relay (not shown) in the HV power supply that disconnects the Variac and applies full line voltage to the primary of the plate transformer in the HI power mode. Another relay in the LV power supply changes both the 813 gridleak resistance and the screen dropping resistor.

Conclusion

My first QSO with the new rig was with my friend Jack who said that I was now pinning the S-Meter and the audio quality was much superior to that of the old 35-watt rig. Since then we haven't had to give up one QSO due to static or QRM. **ER**

R-8040 Receiver from page 7

Item	R-8040	Collins 51S-1
Max first hour drift	25 cps	500 cps
Sensitivity for 10 dB S+N/N	05 uV	0.1 uV
3rd Order IMD dynamic range	80 dB	60 dB
Selectivity		
6 dB	3.1 kcs	6.1 kcs
60 dB	8.7 kcs	20.9 kcs
80 dB	283 kcs	24.9 kcs
AVC – output rise		
5 uV to 50 uV	<1 dB	2 dB
50 uV to 50,000 uV	<4 dB	<1 dB

Figure 1.

detect very strong signals even with no antenna connected due to the open bottom chassis. With the hang AVC circuit, 'summer thunderstorm' conditions keep the receiver dead most of the time.

The calibration errors, BFO noise and need for a bottom plate will be fixed. When I find a suitable two-section pot, the AVC switch on the panel will be connected to disable the AVC and switch in a manual gain control; this will allow operation with heavy static crashes and also make it easier to peak the preselector. The other problems I can live with.

Afterthoughts

Clearly, if you have some vacuum tube construction experience, a homebrew receiver doesn't have to be a toy: with persistence and a few test instruments you can build one which is able to climb in the ring with the best of the well-known vintage sets. There seems to be no reason a set built with 'obsolete' hollow state technology should be second to any but the very best modern receivers; except for the silicon diode, the biggest contribution of solid state technology to the average receiver is in allowing a lot of bells and whistles to be put in a small plastic cabinet.

Because it involves so many different types of circuits, receiver homebrewing is an excellent learning experience. You have to wonder why the ARRL (which ought to want hams to learn technical things) gives us mostly oddities (such as ceiver of and 18 meter band imaging CW receiver of recent Handbooks), toys (direct conversion receivers) and receiver fragments pitched to receiver design professionals as in the *QST* articles of the last few months.

I just hope that Editor Wiseman doesn't have any more challenges for his readers until I can get the matching transmitter built! Now let's see... series filaments, sweep tubes, 7" x 7" chassis, voltage tripler.... **ER**

Armed Forces Day Military Radio Contest Sponsored by AM International

Contest period: Armed Forces Day, May 15, 1993, 7 AM to 9 PM local time.

Contest Exchange: Call, name, signal report, QTH and transmitter.

Contest Scoring: Keep a log sheet for each different military transmitter used. All modes count for contacts. AM phone activity encouraged. Contacts with stations running a military transmitter count five points, other contacts count one point. Score each log sheet by multiplying the number of contact points times the number of different military transmitters contacted. Add log sheet totals. Add 100 points for each contact with an official Armed Forces Day station. Add for grand total.

Send contest results to Dale Gagnon, KW1I, 9 Dean Ave., Bow, NH 03304. Certificates will be awarded to top ten scoring stations. Results will be published in ER.

CLASSIFIEDS

Advertising Information

Subscribers receive 1 free - 25 word- ad per month. **Extra words are .15.** Here's how to count the words in your ad: the heading - For Sale, Wanted, etc count as **1 word**. Your name, call, address and telephone number count as **6 words**. Hyphenated words count as **2 words. Please count the words in your ad and if you're over 25 words send payment for the extra words.**

Non-subscribers: $3 minimum for each ad (up to 20 words). Each additional word is .20. **Please call or write for display rates.**

VINTAGE EQUIPMENT ONLY

ER
P.O. Box 57
Hesperus, CO 81326 **Phone/FAX 303-247-4935**

DEADLINE FOR THE MAY ISSUE: MAY 3

FOR SALE: Repair and restoration on all vintage equipment; 35 years experience. Barney Wooters,W5KSO, 8303 E. Mansfield Ave., Denver, CO 80237. (303) 770-5314

FOR SALE: HT-32B/SX-115, Ranger II, Swan 350D, all ex. condx - BO; Drake 2A, w/2AQ - $175. **WANTED:** Drake NB7 or NB7A; calibrator and/or narrow SSB filter for NCX-5 and/or GT-550A; clean 75A-4. Smitty, AD6V, (209) 255-1177

WANTED: Dynamotor pwr sply for Johnson Viking Mobile; schematics for 30K-4. John Brewer, WB5OAU, 7605 Roberts, NE, Albuquerque, NM 87109.

FOR SALE: Swan 500C, w/117XC - $200; Heath SB-10 - $40; Electrovoice 638 - $30; Drake C-Line - $425; Heath 2-M Lunchbox - $25. Dan Radcliffe, KF9BP, (414) 255-9165

WANTED: Please help duplicate my original station 1958-'67. Need HQ-129X and DX-100B. Prefer VG to exc. condx and currently working. Recently got into ham radio after 25 years away. Will provide active and happy home for above beside the solid-state rig. Dale Cochrane, AA3BK, 14652 Mustang Path, Glenwood, MD 21738. (410) 442-1081

FOR SALE: Hallicrafters SX-110 - $135; Hallicrafters S-108 - $120; Galaxy R530, w/ SC530 spkr, exc. - $270. **WANTED:** 6550 and 8005 tubes. George, (216) 486-6489 or FAX 261-8819

FOR SALE: Collins S-Line aluminum knob inlays: small (exciter/PA tuning) - $1; 30L-1 - $2; spinner/plain (main tuning) - $3. Charlie, K3ICH, 13192 Pinnacle Lane, Leesburg, VA 22075. (703) 822-5643

FOR SALE: New list of 1000's of tubes! Includes new, used, antique, collectible, Majestic and Western Electric types. Send SASE to Jim Cross, 2817 Parklawn Dr., Dayton, OH 45440-1538. (513) 298-5827

FOR SALE: Classic Drake novice station - 2-C rcvr, 2-NT xmtr, 2-CQ Q-Mult/spkr, w/24 xtals, cables, orig. manuals & sales literature, exc. condx. I ship. Michael, WAØEPW/6, (310) 645-5511 after 6 PM PST

FOR SALE: Panadapters - SP44, PR1, RBW-2M; Collins 51J4, ARC-1, F455 F-31, F500 Y-60; Hammarlund SP-200, SP-600JX, HC-10, CA1 125, CA37; GE FM proglines, Lear AMR 12. W2OQI, 17 Inwood, Center Moriches, NY 11934-3335. (516) 878-1591

FOR SALE: Early National type CRR rack mount scope, 2", good condx - $25; National AVD vernier mechanism, 5-1 ratio, 1/4" shaft - $5 each. Alan Dale, W9ZPP, 2824 Forest Ave., Evansville, IN 47712. (812) 424-5208

FOR SALE: Used technical books - radio, electronics, math, military, magazines, etc. $1 for large list. (stamps ok). Softwave, Dept. ER, 1515 Sashabaw, Ortonville, MI 48462

FOR SALE: Hammarlund HQ-120X in good condx, w/manual (copy) - $150; T-368 xmtr, w/manual (copy) - $500 PU or meet within 100 miles of Houston. **WANTED:** TV2-B tube tester; EV 664 mic. Thanks! Tom Smith, N5AMA, 13034 Elmington Dr., Cypress, TX 77429-2062. (713) 376-3436 (h)

WANTED: Manual or copy for Heath DX-35. Will pay for copies. Bill Bogart, KA9CWK, POB 81, Covington, IN 47932.

FOR SALE: Real good CPR-90 - $495; very clean Valiant II, factory wired - $395. Bud, (208) 466-2803 after 8 PM MST

FOR SALE: CU-24/ART-13 capacitor bank - $15; equipment; parts; manuals; etc, long list - $1. **WANTED:** 24-hour digital mech. clock. Joe Orgnero, VE6RST, Box 32, Site 7, SS 1, Calgary, AB, T2M 4N3, Canada. (403) 239-0489

FOR SALE: Early National type**WANTED:** Top and bottom covers and original cabinet for R-390A; data on Cetron UXCVII triodes; manual for HP 606B. Clark Hatch, WØBT, 2546 SE Peck Rd., Topeka, KS 66605. (913) 235-2721

FOR SALE: Lafayette radio operating and service manuals, schematics etc. If I don't have it,they never printed it. Pete Markavage, WA2CWA, 27 Walling St., Sayreville, NJ 08872. (908) 238-8964

WANTED: Unbuilt kits by Heath, Johnson and Knight. Gene Peroni, POB 58003, Philadelphia, PA 19102. (215) 665-6182 days

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FOR SALE: Drake T4XC, R4C, MS4, AC4 - $400; T4XB, R4B, MS4, AC4 - $300; TR4, MS4, AC4 - $250; Astatic D104 - $30; Shure 526T - $55. U-ship. Robert, WB4AXQ, (205) 828-6738

WANTED: Collins 32V-3, 75A-3, 270G3 spkr, accessory items; Lettine 240; MacElroy bug. TRADE: NIB 826 tubes for 4X250B, 4D32. Brian Roberts, K9VKY, 3068 Evergreen Rd., Pittsburgh, PA 15237. (412) 931-4646

WANTED: Be included in directory of vintage operators. Send name, call and address (phone optional) to James Dillon, NØKWA, Rt 6, Box 303-C, New Orleans, LA 70129.

FOR SALE: Gates BC-250-BY broadcast xmtr, nice condx, now on 160 meters - $900. K7BDY, Box 744, Showlow, AZ 85901. (602) 537-2450

WANTED: Hallicrafters HT-32B, good to exc., prefer pickup within approx. 200 miles. Mark Castonia, N9EBA, 2061 True Lane, Green Bay, WI 54304. (414) 494-0787

WANTED: Buy and sell all types of electron tubes. Harold Bramstedt, C&N Electronics, 6104 Egg Lake Rd., Hugo, MN 55038. (800) 421-9397, (612) 429-9397, FAX (612) 429-0292

FOR SALE: R-390A service, module repair to complete remanufacture, cosmetic restoration, 20 years experience, expert service, 1 week turnaround, very reasonable, any cond. accepted. Rick Mish, (419) 726-2249

WANTED: E.H. Scott military RBO, RDO, SLR-12A/B/H. Also need manuals on all Scott equipment. Thanks! Tom Smith, N5AMA, 13034 Elmington Dr., Cypress, TX 77429-2062. (713) 376-3436 (h)

FOR SALE: Original Collins manuals - 32MS-1, 516F-2, 136B-2, 312B-4/5 - $20 each; RBC-2, w/pwr sply, manual, shpd lower 48 - $195; Valiant front panel - $20; 160/75-M AM for $25! Ship/shore xcvrs $15-$35, shpg xtra. WA7HDL, (208) 756-4147

FOR SALE: WW I portable telephone/buzzer, flameproof keys, NOS, 1955, various others, 8 page list - $1 plus SASE J.H. Jacobs, 60 Seaview Terrace, Northport, NY 11768

FOR SALE: Knight T-150 xmtr - $75; Gonset G-66B rcvr, w/manual, wrkg - $60; G-66B rcvr, G-77 xmtr, pwr sply - $80 pr. Mark, (407) 845-7331

WANTED: Used Collins, Drake, Hammarlund general coverage rcvrs. Levy, 8 Waterloo, Morris Plains, NJ 07950. (201) 285-0233

WANTED: Manuals for Navy rcvrs R517/FRR26 and National SCR3B; coil set for Wilcox rcvr CW3. Jon, W7FHZ, 802 Columbia, Fircrest, WA 98466. (206) 839-7688

FOR SALE: HRO-500, not wrkg, fair condx - $375; Heath QF-1 - $12; QT-1 VOX for Central Electronics 20A - $12; handheld mic made for T-368 - $10; tube sockets for 872's and bleeder resistors from GPT-750 xmtr - $20; Simpson AM modulation indicator in carrying case, 1948 vintage - $35; rejection tuning, later version upgrade kit for 51S1 rcvr - $35. Mike Palmer, K5FZ, 16707 Creeksouth, Houston, TX 77068. (713) 444-7737

WANTED: Neon xfmr for Tesla coil project. Andy, WA4KCY, 105 Sweet Bay Lane, Carrollton, GA 30117. (404) 832-0202

FOR SALE: Heath DX-60, HR-10, HG-10 - $100. **WANTED:** R390A cabinet and Collins spkr. Norm Hegyi, KC9D, 9200 Henry Dyer, IN 46311. (219) 365-4089

FOR SALE: Radio tubes; repair and restoration of all vintage amateur and commercial radios, 25 years experience. Herbert Stark, 321 N. Thompson St., Hemet, CA 92543. (714) 658-3444

FOR SALE: "Comet Pro" - $175; Clegg Zeus - $150. Plus shpg. Steve, K6PFW, 848 N. Silverwood, Upland, CA 91786.

WANTED: Collins literature, manuals, catalogs, SM2, SM3, MM2 mic's, TD1, 647T dipole ant, 35C low pass filter, 55G1. Rick Coyne, KD6CPE, POB 2000-200, Mission Viejo, CA 92692. (714) 855-4689

FOR SALE: Repair! All makes and models, homebrew, maximum labor per unit - $96. Dan Rupe, W7HBF, Telo Technology, 1302 S. Uplands, Camano, WA 98292. (206) 387-3558

FOR SALE: Multi-Elmac AF-68 and PMR-6, w/pwr sply - $125 each; RAO-2 - $60; BC-348Q - $100; CE MM-2, w/RM-80 plug in - $125. Cliff Fleury, AI7Y, 64174 Tumalo Rim Dr., Bend, OR 97701.

WANTED: Collins 302C-1, SM-3, SC101, 312A-1, 312A-2, crystal plug-in unit for KWM-1. Butch, KØBS, 5361 St. Mary Dr., Rochester, MN 55901. (501) 288-0044

WANTED: Key and plug assembly No.9 for WS#19 with J-37 key and leg straps. Chris Bisillion, VE3CBK, Whiskeytown Wireless Collection, 1324 Old Carp Rd., RR #1, Kanata, Ont. K2K 1X7 Canada.

FOR SALE: Collector quality B&W 5100B - $250; NCX-5, NCX-3 & pwr sply - $300. PU only. Don, K5DUT, 6080 Anahuac Ave., Fort Worth, TX 76114. (817) 732-3976

FOR SALE: Var. cond., dual 7.9 - 139.4, 1000-V - $10; National neut. cond. - $9; Johnson 250 mmF variable, 3500-V - $17; National 4-gang loading cond. - $15; ceramic edge-wound RF coil - $25. W6CAS, (916) 731-8261

WANTED: Very early Hallicrafters and Hallicrafters/Silver Marshall equipment including Skyriders with entire front panel dull aluminum color, S-30 radio compass, S-33 Skytrainer, S-35 panadaptor, wood console speakers - R-8 & R-12, HT-2, HT-3, BC-939 antenna tuner, parts, advertising signs, paper memorabilia of Hallicrafters. Also want RCA model AVR-11 airport tower receiver. Chuck Dachis, WD5EOC, "The Hallicrafters Collector", 4500 Russell Dr., Austin, TX 78745. (512) 443-5027

FOR SALE: Military monitoring antennas: broadband VHF/UHF discones, biconical types, 30 - 1000 Mcs, shipboard construction, 'N' connectors, preamps, antenna multi-couplers, cables and accessories. Rick Mish, (419) 726-2249

WANTED: WW II- vintage "QST" magazines, 1941-'44 inclusive. Edward Swynar, VE3CUI, 3773 Concession Road 3, RR #8, Newcastle, Ont. L1B 1L9, Canada.

FOR SALE: Greenlee chassis punches, round, 1/2, 5/8, 3/4, 7/8, 1, 1-1/8, 1-5/32, 1-1/4 - inches; square, 1-inch - $15 each ppd. J.J. DeSousa Jr., W1OFK, 29 Whiting St., Plymouth, MA 02360. (508) 746-6533

WANTED: National NC-200 rcvr, w/matching spkr. James T. Schliestett, W4IMQ, POB 93, Cedartown, GA 30125. Tel/Fax (404) 748-5968

WANTED: Tube audio amplifiers: Western Electric, RCA, Heathkit, Fisher, etc., any condx, literature, parts. Can meet at Dayton. Mike Nowlen, WB4UKB, 12911 New Parkland Dr., Herndon, VA 22071. (703) 481-9614

FOR SALE: Mint mil. PM-2 pwr sply - $90; exc.-mint 75S3B RE, 32S3 WE, 516F-2 - $1000. U-ship. Gary Elliott, NO5H, 808 Clarice St., Delhi, LA 71232. (318) 878-8032

WANTED: Johnson accessories, code keys, SWR bridge, station monitor, etc. Even good clean rigs. Bob Kemp, POB 470, Lake City, MN 55041. (612) 345-5345 days

Western Heritage Museum Omaha, Nebraska
"a magnificent home for your equipment"

Leo Meyerson, WØGFQ, (founder of WRL) needs donations of gear and related materials for the amateur radio exhibit at Western Heritage Museum in Omaha, Nebr.

This permanent display is the only one of its kind in the country and is something that all hams can be proud of. We expect 50,000 visitors annually.

Your tax deductible donation will be permanently noted on a plaque that will be prominently displayed.

For more information contact Leo at (402) 392-1708, May-Nov.; 619) 321-1138, Nov.-May.

FOR SALE: Heath Nostalgia - 124 page paperback covers Heath history in pictures and stories. $9.95 postpaid (plus tax in WA). Heath Nostalgia, 4320 - 196th SW., Suite B-111, Lynnwood, WA 98036.

FOR SALE: Collins kHz dials for 75A-1, 75A-2, 75A-3, 32V-1, 32V-2, 32V-3, KW-1, KWS-1 - $30 per dial or $35 exchange. Butch, KØBS, (507) 288-0044

WANTED: TCS xmtr and TCS rcvr. Mort Jones, W6KLC, POB 2131, Ramona, CA 92065. (619) 789-6794

WANTED: Plug-in coil set w/80-M bandspread for pre-war HRO. Dale Martin, W7LOG, 2021 153rd Ave., S.E., Bellevue, WA 98007. (206) 746-3310

WANTED: Collins 32S-3A xmtr, w/516F-2 pwr sply and 312B-5; Heath HW-8 or HW-9; Vibroplex orig. presentation bug; also good quality straight key. All for personel station. Must be in good condx. Lance Wilken, KNØUSQ, 545 Woodland Ave., Fairmont, NJ 56031. (507) 235-9195

WANTED: Coils for Meissner 150B; Globe King 500 or T-368; Heath and Johnson equipment; Hallicrafters SX-73 or parts of. Jeff Wilder, AA8JG, POB 115, Mattawan, MI 49071. (616) 668-4666

WANTED: RME 4301 sideband selector; RME 4302 spkr; S-meter for Hallicrafters SX-99. Doug DeWeese, 502 East 80th St., Tacoma, WA 98404-1014. (206) 472-3478

WANTED: Espionage equipment. Historian purchases spy radios, code and cipher machines and any equipment, devises or manuals pertaining to the world's intelligence organizations. Keith Melton, Box 5755, Bossier City, LA 71171. (318) 747-9616

FOR SALE: NC-173; R-388; freq. counter; M.C. Jones 261,262 power meter .5 to 225 Mcs, to 1 KW; 3 plus KW antenna tuner, HB, w/dual meter for ladder or balanced feedline; BC-610, 160-10, w/coils & TUs; SP-600JX. Possible to deliver the above to NY in summer. **WANTED:** Elmac PMR-7 rcvr. Joe Perratto, K2QPR, 1341 SW Evergreen Ln., Palm City, FL 34990. (407) 220-2189, call anytime.

FOR SALE: Vintage parts. Send stamp and request "Vintage Flyer". USA only. Copies of some obsolete Readrite/Triplett equipment manuals. Bigelow Electronics, P.O. Box 125, Bluffton, OH 45817.

TRADE: My Globe DSB100, 755 vfo, Stancor ST 202A, RAS5, TBS-50 for your AK735/206, GPR-92, NC-240D. A. Bruno, 24 Butternut Dr., New City, NY 10956. (914) 354-8899

FOR SALE: Hallicrafters SX-25 Super Defiant, good condx - $125 plus shpg and handling. James H. Barrows, W7BCT, 15121 41st Ave., S.E., Bothel, WA 98012. (206) 337-4880

FOR SALE/TRADE/WANTED: Vintage tube CB's, all makes/models available; old radio books. LSASE for lists (specify). Charles Zafonte, RFD #1, Box 75, Fort Kent, ME 04743. (207) 834-6273 eves.

WANTED: Intelligence museum wants German, Japanese, Italian, Russian and Chinese communication equipment and any British or U.S. spy radios. LTC William Howard, 219 Harborview Lane, Largo, FL 34640. (813) 585-7756

FOR SALE: HA-1 keyer; HQ-129X rcvr; RAL 6 rcvr. WANTED: R-42 and R-47 spkrs. F.W. Nicholas, (602) 864-9987 after 5 PM MST

WANTED: I'm still looking for McIntosh tube amplifiers. Marcus Frisch, WA9IXP, Box 28803, Greenfield, WI 53228-0803. (414) 545-5237

FOR SALE or TRADE: RF sig. generators - Hickok 288X, Knight KG686, Conar 280, B&K E-200D, Eico 324, Knight KG 650, Eico 330. Al Bernard, NI4Q, POB 690098, Orlando, FL 32869-0098. (407) 351-5536

WANTED: J. Miller 565, 585, BCB AM tuner; HRO-50 coils set G, swap coil set E or cash. Albert Kaiser, W2ZVR, 713 Marlowe Rd., Cherry Hill, NJ 08003. (609) 424-5387

WANTED: Top $ for WRL Q-multiplier SS-1 (1965) and WRL CW-7 xmtr. Gary Wagner, K3OMI, 11124 Oak Hollow Rd., Knoxville, TN 37932. (615) 690-4217 (d)

FOR SALE: Xmtr tubes, 4CX250 Eimac & Amperex - $60 and $50 each. Steve Naetzker, WA2KPI, POB 15123, Long Beach, CA 90815.

FOR SALE: Tempo One SSB/AM/CW xcvr, w/vfo, pwr sply/spkr, mic and manual. John File, POB 566, Tolono, IL 61880. (217) 485-3439

WANTED: HQ-150 or HQ-160; also a 450 pF air variable cap, 1000-1500 volts. Donald J. Spreeman, 543 E. 20th St., Kaukauna, WI 54130-3344. (414) 766-1175

WANTED: Tuning units and plugs/cables for BC-191/375. Also looking for other items related to these radios. Thanks. Andy Miller, Salinas, Calif.,(408) 753-2505

WANTED: Guys, I need your help to finish off a few restorations; 10-M coupler for CE 600L; rack mounted spkr and xtal filter assembly for HRO-5RAI or similar; 2 early HRO coils to cover 2-7 MHz; cabinet for 32V-2; RME 4301 SSB adapter. I have stuff to trade or I will pay cash. Thanks. Dennis Petrich, KØEOO, 6419 Berwickshire Way, San Jose, CA 95120. (408) 997-9835

FOR SALE: Viking II, w/vfo; Challenger, w/vfo; 3 complete Elmac sets and a 2-owner DX-100. Would prefer pickup or will meet up to 50 miles from Columbia, Tenn. John Alden, K4HRY, (615) 388-6060 (d), 388-6500 (n)

WANTED: Main tuning knob and matching spkr for Collins 75A-1; Shure 51 mic. Terry Knapp, KG7ZD, 1937 Valley Dr., Las Vegas, NV 89108.

WANTED

Collins promotional literature, catalogs and manuals for the period 1933-1983. Jim Stitzinger, WA3CEX, 23800 Via Irana, Valencia, CA 91355. (805) 259-2011. FAX (805) 259-3830

FOR SALE: Collins 75A-4 filters: 6 pole ceramic for high quality AM. 3 bandwidths available: 4, 6, or 9 Khz - $83.50 ea.; single pole CW crystal filters - $88 ea. 10% discount for two filters. Money back guarantee. Calif. residents please add sales tax. Vector Control Systems, 1655 No. Mountain, Ste. 104-45, Upland, CA 91786. (714) 985-6250

FOR SALE: R-390A squelch modication: small external add-on module, super sensitive, works great on AM and SSB, 15 minute installation, instructions included - $25. Rick Mish, (419) 726-2249

FOR SALE: Heath audio amps AA-100 and A-C9; Hallicrafters HT-44, w/P.S. Collins tuning knobs. Marty, (817) 497-6023

FOR SALE: Collins Collectors: Collins R-392 rcvr, low serial number, low mfg. date, near mint, operational, w/scarce sandcast, finned case - $350. U ship. Joe Bunyard, 1601 Lexington St., Waco, TX 76711-1701. (817) 753-1605

WANTED: E.F. Johnson telegraph straight key model #114-100; R-48 brass key and other E.F. Johnson accessories. Sumter Hickman, KB5QHD, 1008 West 10th St., Plainview, TX 79072. (806) 293-5809

FOR SALE: (2) Collins R-388A's (clean), w/ manuals - $200 each; SX-28A, unusual, built for FCC - $150; National FB-7 (1933), good condx, orig. pwr sply, coils, spkr and manual - $300; National NC-101S (1936) - $200; TV7/DU tube tester - $30; I-177 tube tester, w/MX949 socket adapter - $30; master oscillator/mult. from Navy TDE/TDK xmtr 80/40-meter output, w/ 802's - $30; ARC-5 rcvr local tuning knob - $10; (2) Heath HW-16's, 15/40/80 CW xcvrs, w/all band conversion data - $25 each; 1931/1937 Q5Ts - $2 each; Eico tube type keyer, model 717 - $15. Will consider trades. Looking for TBY-8, complete or just vibrator pwr sply and Viking II. Roger Faulstick, KD4AS, 210 Mariah Ct., Merritt Island, FL 32953. (407) 453-3312, FAX 453-2258

FOR SALE: Transmitting/Receiving tubes, new and used. LSASE for list. I also collect old and unique tubes of any type. Looking for Taylor and Heintz-Kaufman types and large tubes and sockets from the old Eimac line; 250T through 2000T for display. Maybe you have something to trade? John H. Walker Jr., 16112 W. 125th St., Olathe, KS 66062. (913) 782-6455

WANTED: Johnson gear, all models, any condition. Also parts and literature. Please state condition and shipped price. Wen Turner, AD7Z, Box 451ER, Cal-Nev-Ari, NV 89039.

FOR SALE: 14 x 3/8-inch antenna insulators, made from cycolac plastic - 2 for $2. Made from **WANTED:** Aux. coupling SW for Johnson Viking Valiant. Chuck Keller, WA8RQN, 6785 Rt. 7, South, Andover, OH 44003. (216) 293-6166

WANTED: Thermadore transformers! Final deck robbed! Modulation N24A (300-W primary 6700 OHMA plate class B, secondary 0-4500-5000-5500 OHMA DC 350 MA), driver CH33 (500 ohm line to 805 grids, split secondary, turns primary to secondary 1:1.27). Other mfg. OK, need other parts too for Technical Radio T-350XM xmtr. Know anything? Contact Victor, 7224 NE 8th Ave., Portland, OR 97211. (503) 289-6373

FOR SALE: National RBL-5, w/shock mount base, ex. condx except for stripped tuning sector gear - $50. John Berenyi, 2708 Kayscreek Cr., Layton, UT 84040. (801) 543-1344

FOR SALE: Several ARRL Handbooks - LSASE for list; Hallicrafters S-38abcd's - $55 includes shpg; parting Johnson Viking I, S-40, S-38's, NC-33. No Hallicrafter knobs. **WANTED:** ARRL Handbooks - 1st, 5th and 16th editions. Bob Schafer, WA7IHN, POB 442, Aumsville, OR 97325. (503) 749-1149

ELECTRIC RADIO PARTS UNIT DIRECTORY

If you need a part for a vintage restoration send $2 and an SASE (.52 postage) for a 6 page list of parts units. If you have a parts unit, consider putting it on the list. Your dead unit can help bring others to life!

FOR SALE: Repair & refurbishment of older tube-type amateur equipment. Fully FCC licensed; 35 years experience. Chuck Banta, N6FX, Claremont, Calif. (LA area) (714) 593-1861

TRADE: Radio Shack DX-160 rcvr/spkr/manual, mint (as new) for older rcvr/xmtr/acc., or sell, offers? Richard Prester, WA2IPS, 131 Ridge Rd., West Milford, NJ 07480.

FOR SALE: Heathkit amateur radio repair by RTO Electronics, 4166 Maple St., Berrien Springs, MI 49103. (616) 473-3201

WANTED: For Colorado Bighorn Museum: Hallicrafters HT-33B, S-40B, spkr for SX-101A, SR-34; Heath AK-5 spkr, SB-10, DX-35/40; B&W LPA-1; National SW-54; HRO-60; Collins KWS-1; Gonset G-43, G-63; tubes - 8874 (3), 3CX800 (2). Don Zielinski, KØPVI, (303) 646-4409

TRADE: Clean Hallicrafters HT-33A KW amp for clean HT-45 to match my HT-44/SX-117 station. Dale, WA8SHR, Southington, OH 44470. (216) 898-8215

WANTED: National SW-54; Heath Q-multiplier; Knight T-150 xmtr. Bob Braeger, WA6KER, 6634 Navel Ct., Riverside, CA 92506. (909) 682-5084

FOR SALE: 10 mFd/450-V capacitors, new - 12/$7, 50/$25 ppd; Bird 8361 NM, 10 watt load - $35; 8360 NM 2 watt - $25. Mel Stoller, K2AOQ, 100 Stockton Ln., Rochester, NY 14625. (716) 671-0776

WANTED: A very good to exc. Collins 32V-3 for on-the-air applications. Will PU within 200 miles. Skipp Tullen, K2PXQ, 26 Altamont Ct., Morristown, NJ 07960. (201) 539-8120; FAX 539-5615

FOR SALE: Swan SW 120, w/mobile pwr sply - $90; SW 240, 90% complete - $30; Central Electronics 10B exciter, w/slicer - $80. Dave Mantor, W9OCM, c/o MED, POB 2106, Anderson, IN 46018-2106. (317) 642-1103

FOR SALE: SAMS Photofacts and parts for collectors. Electrolytics, high voltage capacitors, power resistors, plugs, switches and more. Free catalog. A.G. Tannenbaum, WA2BTB, POB 110, East Rockaway, NY 11518. (516) 887-0057, FAX 599-6523

FOR SALE: RIT for KWM-2 and S-Line. No modifications for KWM-2; 75S- needs one wire - $59.95. SASE for info. John Webb, W1ETC, Box 747, Amherst, NH 03031.

FOR SALE: Sig. generators - HP 606A, 50 kHz - 65 MHz, lab quality, w/manual, exc. - $250; HP 608D/TS-510A, 10 MHz - 420 MHz - $89; URM-25F 10 kHz - 50 MHz - $89. Oscilloscopes - USM-281A/HP 180A - $200; HP 180A mainframe only - $100; TEK RM-17 10 MHz rackmount, exc., good station monitor - $75. Large military balloons - $10; Hal DS 2000 keyboard send/receive, w/manual, exc. - $45; AT-197GR military discone antenna - $50; HP 100E freq. standard, mint - $150; USM-207 550 MHz freq. counter - $150. U ship. Joe Bunyard, 1601 Lexington St., Waco, TX 76711-1701. (817) 753-1605

WANTED: All types of military electronics, especially RDF and radar items, manuals too. Also need URD2 antenna. William Van Lennep, POB 211 Pepperell, MA 01463. (508) 433-6031

FOR SALE or TRADE: NOS mil. surplus Eimac 4X150A, 4X150G; .05 @ 600-V and 1500-V caps - 4/$1; 24-V to 115-V inverters, regulated, vibrator type - $40. All plus shpg. **WANTED:** Battery and crystal sets 1920's and earlier. Michael Crain, RR1, Box 472, Harveys Lake, PA 18618-9782. (717) 639-2794

FOR SALE: Restoration of vintage radios; 25 years experience. Phil Goodman, K4FXB, 4112 Commodore Dr., Atlanta, GA 30341. (404) 457-4195

WANTED: Super Pro 400; Pro-310; NC-400 in clean, wrkg condx; kit to add mech. filter to 51J-3; schematic for RME-150A HF converter, copy OK. Fred, (609) 393-4122 after 7 PM

WANTED: pwr xfmr for Heath DX-20 xmtr. Frank Hill, WA6SYI, 1313 Milton Ave., Walnut Creek, CA 94596. (510) 939-2940

FOR SALE: Used BC tubes - 4-400A - $20, 833A - $15, 3CX2500A; UTC xfmr, CG-307, 7000-VCT, 300mA. Keith, W5WBA, 3648 Vista Grande, NW, Albuquerque, NM 87120. (505) 831-2646

WANTED: Modulation xfmr and the large drawer slide for a Johnson Desk KW. Jeff, W7ID, (208) 323-9267

Message: Collect Keys? Subscribe to the Vail Correspondent, your quarterly journal. Informative articles, free ads. USA, $10/yr. Sample $2. TVC, Box 88-E, Maynard, MA 01754.

Announcing: New address for the Colorado Bighorn Museum of Amateur Radio is P.O. Box 601, Elizabeth, CO 80107 for mailing purposes. Phone is (303) 646-4409. Thanks to everyone for your support and interest. Don Zielinski, KØPVI.

FOR SALE: Air variable 400 pF NIB of BC-312 - $22 each; new 705A tubes - $8 each. Andrea Moretti, Via Colle Bisenzio 31, 50040 Usella FI, Italy

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WANTED: Mint Collins 51S1 and HC-10 converter. Thank you. Dan Mason R.RT 1, Box 204F, Santa Fe, NM 87501. (505) 455-3416

FOR SALE: (2) GE 10 mFd, 600-V Pyranol filter caps - $10 each + $4 shpg; (4) 814 tubes - $10 each + shpg. Bill Riley, W7EXB, 863 W. 38th Ave., Eugene, OR 97405.

WANTED: Tube socket extenders and punches; Collins 75A-1; 100TH's; Riders "Basic Electronics", 5 volume series by Van Valkenburgh. George, WAØZYX, 1912 10th St., N.E., Rochester, MN 55906. (507) 288-0242

WANTED: Nameplate for Lionel J-36 bug. Jim Mann, K1TMJ, RFD 1, Box 1183, Anson, ME 04911. (207) 778-3826

WANTED: Elmac AF-68 xmtr, w/AC pwr sply, in good wrkg condx. Ron, W8KYD, 5410 Alber Ave., Parma, OH 44129. (216) 888-1904

FOR SALE: Yaesu FT-101, very good condx, good AM - best offer, around $300. Zeke Adair, W5LUT, 1106 W. 4th, Roswell, NM 88201. (505) 623-0005

WANTED: Johnson Ranger, Viking 500, Desk KW. Bob Bounds, NØNFI, 41097 Co. Rd., 121.0, Model, CO 81059. (719) 846-6265

WANTED: Vernier dial for 1/4" shaft; AM sig. generator, 100 kHz - 100 kHz, in wrkg condx. Beni Fernandez, KP4DN, 1674 Atlas St., Summit Hills, PR 00920. (809) 792-0102

FOR SALE: BC-348R, appearing w/late '50's rebuild tags, dynamotor sply, untested - $150; ART-13, appears complete (all tube etc.), untested - $115, without tubes - $50. Gene, KD4YIX, (404) 457-1915

WANTED: Panel meter, manual and help locating cabinet paint for Johnson Navigator. Stuart Rumley, KI6QP, 308 Nevada St., Redwood City, CA 94062. (415) 369-0575

FOR SALE: We have a large selection of HV capacitors for tube circuits. Check out our Mike-Mate preamp kit, just $8.75. 100 mF 450-V axial electrolytic, new $3.99. Massive 2000 pF 10KV disc, $.79. 1500 pF 5KV tubular film, $.45. 600V .47 tubular film, $.69. Much more, S&H extra. Visa/MC. $1 brings catalog and coupon. USA/Canada only. Two Fox Electrix Co., POB 721, Pawling, NY 12564. (914) 855-1829

WANTED: Alignment info, schematic, etc. for Hallicrafters S22R (Skyrider Marine). Harry Miller, W4PDX, POB 66, Oilville, VA 23129. (804) 749-4770

WANTED: E, F and G coils for HRO-60. Les Layton, 5560 Caladonia Ave., Las Vegas, NV 89110. (702) 452-7768 (days before 2 PM PST)

FOR SALE: Globe King 500C - best offer over $600; R390A - $275. Buddy Travis, KA4NNN, Rt 4, Box 36-B, Louisa, VA 23093. (703) 894-0406

WANTED: In any condx, S-meter for SX-28; National SW-3. Thanks. Dale Knotts, WB8RZQ. (216) 644-1661 after 6 PM EST.

FOR SALE: Hallicrafters S-20R, very clean, orig. manual. **WANTED:** HRO-60 dial scales EFGHJ; HRO-5 coils DFHJ. Carter Elliott, WD4AYS, 1460 Pinedale Rd., Charlottesville, VA 22901. (804) 979-7383

FOR SALE: Geloso G-209 rcvr - $90; URM-25 sig. generator, w/accessories - $70; GRC-9 (depot fresh), w/accessories - $125. Tom Brent, Box 1552, Sumas, WA 98295. (604) 826-4051

WANTED: Johnson Ranger II, any condx. John Pavlovich, W3GDW, 215 William St., Trenton, NJ 08610. (609) 392-2095

WANTED: Hammarlund PRO-310. Hank, W6SKC, (602) 281-1681

FOR TRADE: M-209 cipher machine, OSS/SOE "Spy" radios, and other espionage devises available for trade. Keith Melton, (318) 747-9616

WANTED: Broadcast equipment catalogs and transmitter brochures from 1930-1955. Magazines wanted: "Broadcast News" (RCA), "Pickups" and "Oscillator" (Western Electric). Sam, W6HDU, 1031 San Antonio Ave., Alameda, CA 94501. (510) 521-1429

WANTED: Collins 51J4 rcvr, w/case, spkr and manual. Barry Nadel, Box 29303, San Francisco, CA 94129. (415) 346-3825

FOR SALE: Heath shortwave rcvr, AR-3, as is - $25, restored - $50 + $5 shpg; Sorensen pwr sply, 50-V, 2.5-A DC - $25 + $10 shpg; HP model 3430A digital voltmeter, wrks - $25 + $10 shpg; Trimuph model 333S multimeter, has been restored - $25 + $5 shpg; Coleman solid-state DC pwr sply model 6-065 - $25 + $7.50 shpg; Minco Products thermal indicator models 300, 300D and 314 - $25 each + $5 shpg. James Fred, R1, Cutler, IN 46920. (317) 268-2214

WANTED: Rack cabinet for Globe King 400 or 500. Jim, W9UD, 2716-West 3rd St., Coal Valley, IL 61240. (309) 799-7447

WANTED: Heath AT-1; Turner model 99 dynamic mic. Bill Brossman, 547 Lake Connie Rd., Carrollton, GA 30117. (404) 834-0460

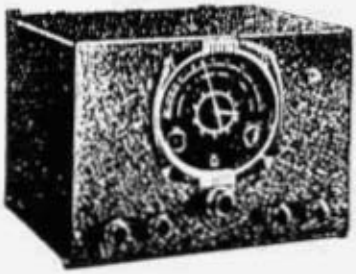
FOR SALE: Johnson Ranger I, w/orig. manual - $125 OBO. Prefer PU. Clem, W8VO, (313) 795-4670

FOR SALE: Drake TR3, RV3, AC3; Heath AR-3; Galaxy V, w/pwr sply and spkr; Central Electronics 20A; CB xtals for Collins. **WANTED:** Acc. plug for KWS-1; 2 knobs for KWM-1. Joel Levine, WB2BMH, 67 Derby Ave., Greenlawn, NY 11740. (516) 757-7641

FOR SALE: Sencore model VB2 Vibra-Daptor. Tests 2 and 4 prong, 6/12-V vibrators. Plugs ito any tube tester - $8 ppd. Ken Greenberg, 4858 Lee, Skokie, IL 60077. (708) 679-8641

WANTED: Photocopy of data sheet for UTC CVM-4 modulation xfmr. Bob Deuel, KA7COS, POB 1181, Medford, OR 97501. (503) 482-8752

FOR SALE: Brimstone 144 2-M FM by WØBT (see ER #19), Heath SB-500 rare 2-M transverter, mint - $145 each, orig. manuals. Bill, KE7KK, 6712 Lake Dr., Grand Forks, ND 58201. (701) 772-6531



WANTED: Any condition, Hallicrafters Sky Master and EP-132 as shown. Also want SX-46, S-48 and S-49. Chuck Dachis, 'The Hallicrafter Collector', 4500 Russell Dr., Austin, Texas 78745. (512) 443-5027

FOR SALE: Tektronix model 575 transistor curve tracer with mod 122C, manual and adapters, exc. cond. - $500. Don, W7KCK, (503) 289-2326

FOR SALE: SX-71, wrkg, w/manual (copy) - $150 plus UPS. Bud Santoro, 3715 Bower Rd., Roanoke, VA 24018. (703) 774-9153

FOR SALE: Choke, 2.5 Hy, 280 mA, 43 ohm, upright open frame, 3C317-22, NOSB - $2.50, 5/$10; DY-17A/ART-13, NOSB - $45. Plus UPS. **WANTED:** Aluminum CS-48's, buy or trade steel ones; rectifier RA-34; power unit PE-49; BC-191/375 tuning units, prefer A-version. Robert W. Downs, WA5CAB, 2027 Mapleton, Houston, TX 77043. (713) 467-5614

FOR SALE: HRO-500, w/manual & orig. brochure, mint - $850; Drake MSR/FM-P marine version DSR-2, mint - $700. **WANTED:** Marconi 1950's marine shore station rcvr. K3ES, (412) 621-3977

FOR SALE: Collins 'Meatball' lapel pins, stamped metal, baked enamel finish. A nice replica of the Collins round insignia. May be used to replace a missing panel logo on the S-Line, KWM-2, etc. $5.95 ea. plus $.75 S&H. George Pugsley, W6ZZ, 1362 Via Rancho Pkwy., Escondido, CA 92029.

WANTED: Crescent shaped, metal dial plates 0-100 divisions, approx. 1" wide by 4" overall length, with pointers if available. Roland Matson, K1OKO, RFD #1, Box 2943, Kennebunk, ME 04043. (207) 985-3751

WANTED: For BC-151 - cord CD-103, loop antenna LP-7; BC-49; BG-50; CS-41. Bruce Haffner, WD9GHK, 8515 W. 165 Pl., Tinley Park, IL 60477. (708) 614-6134

FOR SALE: SX-24 Skyrider Defiant - $75; HT-18 exciter/vfo, exc. - BO; HT-7 freq. standard, clean - BO; NC-183, w/matching spkr, VG, - BO, PU only; NCX-1000, manual, exc. - $500 PU only; DX-60, wrks FB, scratches on cover, rest exc. - $45; HG-10B vfo, exc. - $35. All plus shpg. Richard Lucchesi, WA2RQY, 941 N. Park Ave., N. Massapequa, NY 11758. (516) 798-1230 eves.

WANTED: Urgent! Pwr xfmr for Collins 516F pwr sply (KWM-2). Jim, K7BTB, Box 30355, Parks, AZ 86018. (602) 635-2117

WANTED: Heath DX-100 or 32V-3 xmtr within 150 miles of my QTH. Jim Schnecker, 621 Wyandotte St., Bethlehem, PA 18015. (215) 868-4159

FOR SALE: ASM-95 Navigation xmtr, w/SA-1641, T-1110, 3 zero boxes, VG condx - $300. Fred Clinger, WA8KJJ, 417 Beechwood Dr., Galion, OH 44833. (419) 468-6117 after 6 PM

WANTED: Early Hallicrafters - any condx. Also SX-88, Blue Racer, JT-30 and Breting 99. Tom Lucht, 9317 Jaynes, Omaha, NE 68134. (402) 571-0688

WANTED: The following for RAK rcvr: CNM-66097 loop antenna, CRV-23073 control unit, and antenna plugs. Tom Brent, Box 1552, Sumas, WA 98295. (604) 826-4051

FOR SALE: Dial calibration is easy with our Tri-Mark crystal calibrator. Uses 9V battery or rectified filament voltage. Three outputs provide rock steady signals from broadcast to UHF. Great pocket signal source. Kit $17.95, assembled $24.95. $4 S&H, VISA/MC. USA/Canada only. $1 brings catalog and coupon. Two Fox Electrix, POB 721, Pawling, NY 12564. (914) 855-1829

WANTED: Orig. RAX manual; info on RBZ rcvr; USM-32 scope; USM-390 sig. generator; ARC-5 rcvr bottom cover and tube cover, 2 xmtr/2 rcvr shock mounts. Mel Stoller, K2AOQ, 100 Stockton Ln., Rochester, NY 14625. (716) 671-0776

WANTED: Any of the following, complet or parts units - R-390, R-392, Heath SB-series, Mohawk, SB-500, SB-310, SB-313, single banders, etc. Byron, WA5THJ, 1920 Maxwell, Alvin, TX 77511. (713) 331-2854

FOR SALE: Very nice 75A-4 (#1466) with 3 filters - $495. **WANTED:** Balanced modulator unit for HT-37. Marv, AAØHL, RR1, Box 44, Lehr, ND 58460. (701) 378-2581

FOR SALE: Spectrum display unit L.T.V. G-186G, I.F. freq. of 455 - 500 kHz, w/manual - $175; L.T.V. G-175C VHF rcvr, w/manual - $200. U ship. Joe Bunyard, 1601 Lexington St., Waco, TX 76711-1701. (817) 753-1605

Manual, repro, TO 16-55-109, Nov. 1944, spare parts list SCR-274-N. A must for the serious collector. Parts list of all SCR-274 units, symbols, quantity, part descriptions, contractor part no's. Covers rcvrs, modulators, dynamotors, mounts, etc. $10 plus postage. Lee Frank, P.O. Box 60011, Harrisburg, PA 17106-0011

FOR SALE: Real audio for your R-390A. Send me your audio chassis (no junkers please) and I'll ship you a ready-to-play chassis. If you're not happy (for any reason) return the chassis (within 30 days) for a full refund. Specs will equal or exceed those specified in ER #42 article - $119 shpg prepaid. Allow 30 days for delivery. Bill Kleronomos, KDØHG, DBA Longmont Labs, 224 Main St., POB 1456, Lyons, CO 80540. (303) 823-6438

FOR SALE: QST magazines - 1923 to 1949 and 1960 to present. Single issues or quantities. CQ magazine Volume 1, numbers 1,2 & 3. Gear - Collins bug; Collins R-390A. SASE for list. Don Merz, 47 Hazel Dr., Pittsburgh, PA 15228. (412) 344-0956 (7 PM - 10 PM EST)

WANTED: Manuals for Hunter Bandit 2000B and Hunter station control; Heath Warrior HA-10; Collins 51J-3. Originals preferred, copies OK. Jerry Kethcart, WB9YMT, 16620 Robinhood Dr., Orlando Park, IL 60462. (708) 532-9245

WANTED: Hammarlund HC-10 or SPC-10 SSB converter; Central Electronics sideband slicer; Collins 353B-31 or -12 plug in; Technical Material Corp. model SBC-1 sideband converter; antenna coupler model CU-872. Please state condx and asking price. Shaun P. Merrigan, 14203 - 72 St., Edmonton, AB T5C 0R4 Canada.

NOTICE: The Rhode Island Amateur FM Repeater Service will hold their annual spring auction and flea market at the VFW Post 6342, Main St., Forestdale, RI on Saturday, May 15. For further info contact Rick Fairweather, K1KYI, (401) 725-7507 between 7 and 8 PM

WANTED: PE-103 dynamotor; BC-450 command rcvr control box. Pete Hamersma, WB2JWU, 87 Philip Ave., Elmwood Park, NJ 07407.

WANTED: Clean 75S-1, WE or RE. Don Jensen, WØREO, (303) 669-6640

FOR SALE: Field antenna sets, AS-2851, (Hy-Gain LP-1402AB) 30-76 MHz, log-periodic, 65W ave., 135W PEP, 50 ohm input, vert. or horz. polarization, longest element tip to tip 16 ft., 8 in., boom length 6 ft., mast assembly 20 ft. fully extended, folded antenna set 4 ft., pack wt. 30 lbs; portable set with antenna, 25 ft. RG-58, ropes, stakes, masts, hammer, bag, instructions, 52 lbs shp., unused - $115 plus shpg. Tartan Electronics, Inc., Box 36841, Tucson, AZ 85740-6841. (602) 577-1022

WANTED: Matched set of Sylvania only 6JB6 finals for TR4-C. Three tubes. Doug McArtin, N2QPX, 4 Portland Pl., Yonkers, NY 10703. (914) 968-3560 after 5 PM EST

WANTED: Drake 2-BQ, 2-AC xtal calibrator, 2-BS; need junker 2-B rcvr for parts; operator manual for Heath signal tracer and Simpson 269 VOM. John B. Keil, 4618 Norwalk St., Union City, CA 94587. (510) 471-4838

FOR SALE: LSASE for list of ham, military, test equipment, books, parts, etc. Gary Cain, 1775 Grand, #302, St. Paul, MN 55105.

WANTED: Hallicrafter SR-150 junker; a pretty SX-117; Shure 51 mic. Terry Knapp, KC7ZD, 1937 Valley Dr., Las Vegas, NV 89108. (702) 647-5729

TRADE: BC-654-A xcvr, w/handcrank generator for other AM gear. Alan Barlow, 8838 West Hill Dr., Pinon Hills, CA 92372. (619) 868-5994

FOR SALE: Philco 37-620 Tombstone - $115; Stromberg Carlson 325H - $95; Zenith 4K035 farm radio, untested - $60; Sparton 141XX - $75; Watterson 527 - $50; SX-71 - $125; BC-779 military super-pro - $125. All above in good condx. UPS xtra. Bud Santoro, 3715 Bower Rd., Roanoke, VA 24018. (703) 774-9153

WANTED: Squires-Sanders equip., parts, manuals & brochures. Top $ paid. Gene Peroni, WA6NNR, POB 58003, Philadelphia, PA 19102. (215) 665-6182 days

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FOR SALE: Military tech manual listings, largest stock in the world, over 50k - $5 refundable with first order. SASE for inquiries. Lee Frank, POB 60011, Harrisburg, PA 17106-0011.

FOR SALE: Electronics suite from U.S. aircraft carrier. MF-UHF rcvrs, xmtrs, radars, PPI displays, RTTY cnvters, terminals. Much more. Bob Mantell, W6VQT, 3135 N. Ellington Dr., Los Angeles, CA 90068. (213) 851-2786

FOR SALE: Manual copies - FM 24-24, 1977, Radio and Radar Reference Data, 192 pages - $15; FM 24-25, Dec. '83, Wire and Multichannel Reference Data, info on telephones, switchboards, radio terminals, and similar equip., 304 pages - $25; TM 11-5800-213L, Sept. '84, list of manuals for Army communications electronic equip., 421 pages - $30; TO 31R-1-8, 1961, Radio Equip. Directory, copy of a copy, cover sheet missing, 340 pages - $25. Copies are unbound. Add $2.90 shpg per manual. Tartan Electronics Inc., Box 36841, Tucson, AZ 85740. (602) 577-1022

WANTED: Collins 75S3-C rcvr in good to exc. condx. Len Koss, 16 5th Place, Syosset, NY 11791. (516) 921-2392

WANTED: Manual and schematic for Superior Instruments model 70 utility tester and Eico model 320 sig. generator. D.W. Naylor, WAØCTE, 509 Brown Circle Dr., Osawatomie, KS 66064. (913) 755-4462

FOR SALE: Heath HW-20 Pawnee 2-meter AM/CW xcvr - $75; HX-20 SSB/CW xmtr - $75; Globe Scout 65A cabinet - $20; Gonset GSB-100 cabinet - $40. Franklin S.H. Young, KH6CDO, 2816 Poelua St., Honolulu, HI (808) 988-7474

WANTED: 80 meter RF coil for 75A-4; Collins 32V-3 in good condx, w/manual; Collins 302C-3 wattmeter. Bill White, Box 1924, Greenville, TN 37744.

FOR SALE: GR 1301A low distortion audio osc., clean and complete, but needs wrk - $20; GR 1932A distortion and noise meter, exc condx - $60; Heath HD-1 distortion meter, reconditioned - $30; Heath AV-2 AC VTVM, VG condx - $15; HP/Boonton 202J VHF sig. generator 195-270 MHz, metered int./ext. AM 0% to 100%, metered FM deviation, with selectable ranges of 15, 30, 150 and 300 kHz, internal audio modulation frequencies of 50 Hz, 400 Hz, 3.9, 10.5, 30, 70 and 100 kHz, 50 ohm output, 0.1 microvolt to 200 mv via calibrated attenuator, unmodified, no manual - $50; HP-425 microvolt meter and probe, fair, no manual - $15; HP-608C sig. generator 10-480 MHz, w/ internal 400/1000 Hz metered AM or pulse and external AM and pulse modulation, RF output from 0.1 microvolts to .5 volts, w/calibrated attenuator - $50. All operational, w/manuals unless noted. Shpg xtra. Bill McCombs, WBØWNQ, 10532 Bartlett Ct., Wichita, KS 67212-1212. (316) 722-7669

FOR SALE: Heath SB-401 SSB xmtr, w/xtals & manual, very good - $80; International Crystal FM-5000 freq. meter, w/plug-in oscillators & manaul, operating condx unknown but physically good - offer; complete set of Signal Corps FT-241A xtals labelled channel 0 thru 79, 20.0 - 27.9 MHz - offer; good backup rig - TS-520S, works fine, looks good - $265. Wayne Arnett, AI7C, 2699 Mazatlan Dr., Grand Junction, CO 81506. (303) 241-3474 days

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WANTED: Radio Shack DX-400; Uniden 2021; RME 4350 & 6900 rcvrs; mutual conductance tube tester, preferably Hickok. With manuals prefered. Rick, K8MLV/Ø, 1802 W. 17th St., Pueblo, CO 81003. (719) 543-2459

FOR SALE: Johnson Invader 200 - $150; Heath SB-10 - $80; parting out Viking II, Ranger I, SX-28 and NC-183; manuals for vintage equipment - see our ad this issue. Gary, W7FG, (918) 333-7893

WANTED: AC pwr sply for NCX-3. Russ Hunt, W9HZD, 14 Siros, Laguna Niguel, CA 92677. (714) 363-8119

FOR SALE: BC-348Q - $75; AN/GRR-5, w/ manual - $85; tubes - cheap; Hallicrafters S-12, nice - $225; tube CB's - $30 each. Jerry, (207) 943-8823

FOR SALE: Jennings Radio KW amp., custom built for Cal. DX'er in 1957, 80-10-meters, 2 vacuum variables per band, vacuum relay switching, 4CX1000 (Jennings showroom in a box) - $700; Gates modulation monitor, 1946 - $130; National NC-TV7M7" TVW/videometer - $475; Pierson DeLane PR-15 (Patterson), no cabinet - $90; 2 new RCA 833A tubes - $150/ pr. Will swap above items. **WANTED:** Early Collins 75A-2 (metal excutcheon); pre-1950 Collins brochures. Gary, WA9MZU, 1751 Michon Dr., San Jose, CA 95124. (408) 266-2218

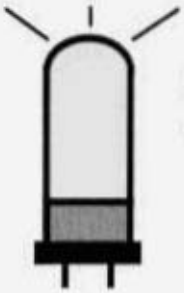
FOR SALE: B&W 5100-B, w/51SB-B sideband adapter and orig. manual - $250; Globe Champion 300, w/manual - $150; Polycom 62, w/manual - $35; Globe Sideband DSB-100, w/ manual - $35; new 100TH - $50. Offers cheerfully discussed. Please ask for 3 page list. Clyde Sakir, N7IOK, 4243 E. First St., Tucson, AZ 85711. (602) 323-1120

WANTED: CV-591A/URR converter; (4) 1614 tubes; BC-669 components. Mike McDermott, WØBVA, 305 N. Keith St., Scammon, KS 66773. (316) 479-2756

TRADE: Your National SW-4 for my nice SW-3 & $200. **FOR SALE:** Wilcox CW-3 rcvr - $25. Robert Enemark, W1EC, Box 1607, Duxbury, MA 02331. (617) 934-5043

FOR SALE: KW Matchbox, w/SWR - $225; Drake 2A - $90; ART-13 - $140; 51S1, RE, - BO over $750; KWS-1 - BO; parting SX-24. Joe Sloss, K7MKS, (206) 747-5349

WANTED: E.H. Scott military RBO, SLR-12A, REE, RCK, SLRM. Also need manuals/ schematics. Thanks. Tom Smith, N5AMA, 13034 Elmington Dr., Cypress, TX 77429. (713) 260-5842 (d)



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